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THE

AMERICAN NATURALIST

AN ILLUSTRATED MAGAZINE

OF

NATURAL HISTORY

EDITED

BY A. S. PACKARD, JR.

ASSOCIATE EDITORS

PROF. G. L. GOODALE, DEPARTMENT OF BOTANY
DR. R. H. WARD, DEPARTMENT OF MICROSCOPY

VOLUME X

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BOSTON
H. O. HOUGHTON AND COMPANY
CORNER BEACON AND SOMERSET STREETS
NEW YORK: HURD AND HOUGHTON
The Riverside Press, Cambridge
1876

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The Riverside Press, Cambridge:
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THE

AMERICAN NATURALIST.

Vol. x. — *JANUARY,* *1876.* — *No. 1.*

BURS IN THE BORAGE FAMILY.

BY PROFESSOR ASA GRAY.

A BUR in the light of morphological botany may be seen to be a seed, a fruit or a portion of one, a calyx, an involucre, or what not. Under the teleological aspect, which was once thought to be expelled from natural history, but which has come back in full force, a bur is one adaptation for the dissemination of seeds by cattle or other animals.

One of the most familiar burs is that of the common hound's-tongue (*Cynoglossum*), of the Borage family; and those of one or two species of stickseed (of the nearly related genus *Echinospermum*) are equally troublesome, clinging as they do to the fleece or hairy coat of domestic animals and to clothing. These burs, morphologically, are not seeds, but quarter portions of seed-like fruits. They adhere for transport by means of prickles or projecting points, which are either barbed or hooked at the tip; the grappling organs in some cases occupying the whole surface of the pericarp, in others particular portions of it.

It is rather interesting to notice how in the same family, that is, among plants all constructed on the same particular plan, this same purpose is effected or attempted in different ways, and, as we may say, more or less successfully. The occasion of these remarks came to me with a new plant of this order in which the bur proved to be formed of different materials from the ordinary burs of the family.

It is worth noticing, moreover, that in what botanists must consider one and the same genus, and, so to speak, of one blood, the grappling organs may be either more or less developed, or rudimentary, or even wanting altogether, or when wanting to the seed-like fruits, may be developed on some neighboring part.

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The genus *Eritrichium* here offers instructive illustrations. It is very nearly related to the stickseeds. One end of its series of thirty or forty species is very near to *Myosotis*, or forget-me-not; the other, in all its characters other than that of the grappling fruit, comes very near to *Echinospermum*, or stickseed. Now, among species at both ends of the series — in some and not in others — a tendency to bur-like fruit is manifested. The four seed-like nutlets, either smooth or moderately and variously roughened, fall out of the calyx at maturity, and take their chance. But in a few of them, in one especially which is found upon our higher Rocky Mountains, a wing-like circle of prickly teeth is developed around the back, which calls to mind the similar grappling border of a common western stickseed, except that its rays are not barbed. Yet in a recent monograph of the American species it is said that " they bear a few rigid, bristly points; which only need to turn backward to be glochidiate," that is, to become grappling barbs. In another species, *E. Californicum*, the little nutlets usually have a merely wrinkled or roughened surface; but we have lately observed, in what we must regard as a form or state of it (var. *subglochidiatum*), that the crest of the rugosities rises here and there into short, bristly points, and the tips of some of these, under a lens, show minute but distinct backwardly turned barbs. Then, quite at the other end of the genus there is a species, *E. pterocaryum*, which has three of its four nutlets wing-margined, the wing essentially resembling that which, in the commoner stickseed of the same western region, often connects the rayed circle of barbs; and this wing is now and then found to be broken up into narrow lobes or teeth, which only need barbs to convert this outlying *Eritrichium* into an *Echinospermum*. The bearing of such facts upon the question of the origin of the efficient burs of stickseeds and the like is obvious.

But this same genus, *Eritrichium*, in some cases secures dispersion by cattle in another way. It is a common character of the Borage family to have the herbage and the calyx beset with stiff and sharp bristles, in some even pungent or stinging. In one set of species, nearly confined to our western plains and thence to California (the section *Krynitzkya*), the fruit-bearing calyx inclines to close loosely over the four small and smooth or unappendaged seed-like nutlets, at maturity a joint forms underneath, and the whole falls off together. In most of these the bristly hairs that clothe the calyx are particularly strong and sharp; and, as they spread in all directions, the whole, if caught in the hairy coat of passing animals, is likely to act as a sort of four-seeded bur; the bur here being a fruiting calyx instead of a quarter-section of pericarp. The bristles being straight and smooth, their hold is precarious. We know of no species in which they become hooked. But just that occurs, on a small scale, in nearly half the species of the related genus *Myosotis*, mouse-ear or forget-me-not; that is, the stronger bristles on the calyx are neatly hooked at the tip, and so a sort of bur is formed. It would be more effective if the fruit-bearing calyx disarticulated more readily from its pedicel.

This brings us to the new genus already referred to. It is an insignificant little plant in appearance, recently found by Dr. Edward Palmer upon Guadalupe Island, off Lower California. The specimens were mixed with those of a *Pectocarya* (native to California and Chili), which in aspect they much resemble. But in *Pectocarya* the four-lobed and four-rayed fruit is itself a bur, grappling by a fringe of marginal bristles or slender teeth with hooked tips. But in our new plant, which I have named *Harpagonella*, the nutlets or seeming seeds are perfectly smooth. There is in the flower the ordinary provision for four of them; but two of the lobes on one side seem to be abortive from the first, while the other two grow to an unusual size, compared to that of the blossom. As they enlarge, so does the calyx on that side of the flower, but not on the other. The two conjoined calyx-leaves of that side, united by their contiguous edges almost to the tip, as they increase in size soon begin to fold around one or the other of the growing nutlets, — it seems indifferent which, — leaving the other one "out in the cold," forming a sort of husk which incloses it completely, and then develops from the outside five or six long and narrow finger-like processes, and along the length of these forms a set of hook-tipped bristles, thus producing a most effective bur.

As to the other seed, it apparently starts as fair as its preferred twin-companion, and sometimes it grows to almost the same size and matures its embryo, but more commonly it fails to mature.

This is a curious case of "natural selection," and a sacrificing of three for the greater advantage of one. For an advantage we must presume it to be, or to have been, to be thus protected and provided with means of transport; else, under any view, it would not have come to pass. Moreover, this is a sort of case which is comparatively intelligible under the supposition that it has come to pass in the course of time and the course of nature; while the supposition of its specific creation in this way at the first, on the plan of destroying two of the four at the birth, and giving one of the remainder a diminished chance for existence, is an utterly bewildering conception.

I know not what quadrupeds or other animals there may be upon Guadalupe Island, of which this bur may have taken advantage for dissemination. I presume there are, or have been, such animals upon the island. But even if there are none, the hypothesis of the development of this bur under natural selection will not thereby be negatived. For although we know of this plant only there, we are not bound to suppose that it originated on this small island. The island is now used as a breeding-place for Angora goats. As they come to be distributed upon the adjacent main-land, we may expect that the little *Harpagonella* will take advantage of the offered means of transport, and compete with its relatives already established there.

THE FLORIDA CHAMELEON.

BY REV. S. LOCKWOOD, PH. D.

WITH the opening of summer, the teaching naturalist is sometimes delighted at finding on his lecture table a curious or attractive specimen from the local fauna or flora. Perhaps the object is the more interesting as being the contribution of some enthusiastic pupil. Sometimes it happens that the object has been, at some cost of trouble, obtained from a distance. In this way, early last June, a pleasant surprise was sprung upon the writer, who found on his table a box containing four small lizards from Florida. Poor little things, there were eight of them when they left the sunny South; for alas, four had perished from the roughness of "the middle passage." They had been unskillfully packed, or rather not packed at all; and the shaking they had experienced had been too much for them. That day another died, leaving but three. To get them home I had a ride of thirty miles by rail. Having put my little box safely in a corner of the car, between the coal-bin and the stove, I took a forward seat, and from the effects of late work the night before soon fell into a doze of a few minutes. I was awaked by the noise of the passengers. Happening to look on the floor of the car, I beheld, to my dismay, the youngest of my lizards under the seat immediately before me. It had got out of the box, and had crept under the seats. With a singular aspect of quizzical timidity it was peering innocently at me out of its pretty, beaming eyes. Now these little things, so purely innocent, are in their movements as quick as light. Something must be done, and very soon, or I and my pet were both undone. If seen by one of these garrulous women, the resulting commotion will be of a sort to defy all sober imaginings, for the little innocent will loom up into the presence of a rattlesnake with four legs, seeking whom he may destroy. I stooped slowly and cautiously. How fortunate! I covered its escape with the first movement of my hand. How the tiny thing did squirm! I took it quietly back to the box, put its nose at the hole whence it had escaped, and so had it once more secure. All these tactics were gone through without attracting the notice of any one; and so, greatly relieved, I resumed my seat as if nothing had happened.

Soon a small fern case was improvised. The sides were glass, and for the sake of giving air, the top was covered with a piece of lace. The bottom was spread with Sphagnum, moderately moist. Into this were set some very small ferns, two species of Drosera or sundew, and in one corner a small specimen of Sarracenia, or pitcher-plant; this was so elegantly marked that it seemed like those antique carnelian cups which one reads about. Gracefully trailing over this mossy bed was the dark, bright-leaved Mitchella. To imitate a contiguous lake or pond, at one corner a shallow vessel of water was sunken in the moss. In this pretty garden our three pets were placed. The design was a mimicry of their own sub-tropical surroundings, with the hope of getting them to feel sufficiently at home to exhibit some of their peculiar traits.

As our little strangers are now snugly domiciled in their new home, some account may be attempted of their family relation and individual habits.

This little reptile is found as far north as South Carolina, hence it is known in the books as the green Carolina lizard. Visitors to Florida seem by almost common consent to have named it the Florida chameleon. While structurally there is in the reptile thus indicated a very wide difference from its namesake, yet there are relationships between them, one of which is notably suggested in the faculty of changing the color of the skin. Indeed, naturalists have regarded this little thing as the representative or analogue in the New World of the chameleon in the Old. Our Florida lizard is a member of the Anolis group, which contains the prettiest specimens of the lizard tribe. The specific name of our subject is *Anolis principalis.* I have not seen one picture of this exquisite little creature in the popular books but is a shameful caricature. So graceful is it that one cannot look at it long without forgetting its reptilian rank. The head is quite flat, and may be likened to a pyramid, with two of its opposite sides much wider than the other two. The teeth are very small and quite pretty, much like the teeth of the very finest jeweler's saw. They are flattish, and pointed, triangular, and the back ones have on each side of the tooth a little spur, also the shape of the central part of the tooth. When first seen the feet present a striking appearance, owing to the very wide and sprawling divergence of the toes, each of which, except the fifth, which is almost rüdimentary, is flattened out into a leaf-like spread at the last joint, or the joint next to the delicate, bird-like claw. The scales of the back and sides are so delicate as to give the appearance of a very fine shagreen. Altogether the animal has the aspect of grace and frailty. The one on my table measures seven and a quarter inches from front of lip to tip of tail, which at its base is the one eighth of an inch in diameter, whence it tapers gradually until it ends in the thickness of a mere thread. Indeed, of the seven and a quarter inches total length, four and a quarter are taken up by the tail, so that the actual body is but three inches long. And this airy little body has hind limbs an inch and a half long, giving it great jumping power. In my specimens, contrary to the descriptions in the books, the normal color is a bronze-brown for the back and sides, with a central stripe along the vertebral column of a steel-gray. This warm bronze is made deeper by the presence of innumerable minute markings of lines, zigzags, and chevrons, of a very dark brown. The entire under side is of an ashy or greenish white.

Soon my pets made themselves at home. Two of them, however, were evidently ailing. In fact, only one of them quite got over the rough experience already mentioned. The principal food furnished them was flies, of which they were very fond. We would put them into the fernery unhurt, so as to see the Anoles catch them. The two ailing ones showed little energy in the matter, and, in truth, took their food daintily. The conduct of the other was very different. He would set himself up so pertly, and would cock his bright eyes so knowingly at us, and at a fly at the same time, that we came to regard him with special partiality. His movements were so quick and graceful, and withal he was so watchful, while the others were so stupid, that he won for himself the pet term Nolie. Indeed, Nolie became, despite his timidity, quite entertaining. For one with so little in his head his ways were often smart, and sometimes there was just enough of selfishness to make things spicy. If he saw a fly walking in the moss, there was first that quick twitch of the head which brought one eye squarely upon his prey. This was to reconnoitre the situation. Then followed the quickest little poke of that nose like a shot, and the fly was taken in and most legitimately "done for." The captor would slightly elevate his muzzle, give two or three champs of the serrate jaws, at least two real efforts at deglutition, and the prey would disappear. Now in this little act of picking out the fly from its entanglement in the leaves of the Sphagnum, it is worthy of note that the whole process had all the precision of an engineer's formula, it was so direct and so neatly done. One of my children put two small toads in with the lizards. As all know, the toad has a projectile tongue with a glutinous tip. This is darted at an insect, which is inevitably captured, and disposed of in the twinkling of an eye. How often, even with so perfect an apparatus, have I seen the toad bring into its mouth, besides the prey, some extraneous object, such as a bit of leaf or straw. Anolius does its work better than that, though its tongue gives it no aid whatever.

I have just been watching Nolie eying a fly which was walking on one of the glass panes of his house. He made a noiseless advance of about three or four inches; then followed a spring, when he was seen cleaving to the glass by his feet, and champing the captured fly. I saw him once intently watch the movements of a fly which was walking on the glass. As seemed evident to me by an ominous twitch of that little head, his mind was made up for a spring; but lo, there was a simultaneous make-up of mind on the part of the fly, which at this juncture flew towards the other side of the case. Then came — and how promptly — mental act number two of Anolis, for he sprang as the after-thought directed, and caught the insect on the fly, midway between the two sides of the fern case. There was surely very fine reckoning here. And what definite decision and prompt execution! At one time one of the feeble ones, as it hung in a corner of the case by its adhering feet, to my joy caught a fly which happened to walk right before its nose. Nolie had been eying this fly, and probably he was only waiting for the insect to be still a moment on the glass. He had waited too long. So, at any rate,

[illegible] think [illegible] with one leap he nipped the protruding
[illegible] and snatched it from the mouth of its proper
[illegible] that is very naughty of you, but quite
[illegible] much of human sharp practice in it."

[illegible] the dreaded potato beetles, *Doryphora decemline-*
ata [illegible] in great numbers. It occurred to me to put
[illegible] The little toads saw them at once, and
[illegible] gleamed with a greedy satisfaction. Quicker
[illegible] one of the Bufos swallowed three of
these [illegible] specimens, and his comrade did the same by two.
[illegible] taken in, and the Bufos
[illegible] was especially observable of the one
[illegible] three specimens, despite the grotesque
[illegible] that there was a certain dolorous air
[illegible] suffering from an overdose of Doryphora.
[illegible] with no other food, neither Bufo
[illegible] again. And as to Anolis? Ah, he was
[illegible] *Was* our Nolie more knowing
[illegible] more circumspect, and did not "go
[illegible] could not stomach these offensive
[illegible] Anolis did not fancy beetles, any way.
[illegible] flies, while an occasional spider was
[illegible] speaking of spiders in this connection,
[illegible] naturalist who sent from Florida, to a
[illegible] moss, *Tilandsia usneoides.* He had
[illegible] one of these inoffensive lizards.
[illegible] destination, and when opened, out popped
[illegible] the dreadful thing! Don't touch it!
[illegible] as you do!" There was quite
[illegible] disturber of the peace was
[illegible] lady friend of ours, "who de-
[illegible] things." It was a lucky transfer
[illegible] carried her new pet
[illegible] care and good judgment.
[illegible] only procurable food.
[illegible] were made to yield
[illegible] was all this done that
[illegible] her little chameleon,
[illegible] They are very fond of
[illegible] catching the large
[illegible] The spider bit the
[illegible].

When the first sharp days of October set in, the lizard surprised me by a specimen of adaptation to circumstances. It had seemed hitherto incompetent for anything of that sort. It selected a hummock of dry Sphagnum, and with its nose worked a hole something after the manner of a toad while making its hole. Letting it do all it could alone, I then deepened the little burrow with my finger. This was to be its sleeping-place, and the little troglodyte has occupied it steadily, and has slept in it every night now for five weeks.

This 6th of November is delightfully bland, following as it does a raw, bleak day. The sun is now full upon the fern case in the window, and Nolie puts its head out of his sphagnum cave. After many twitchings right and left, for about ten minutes, it resolves to go out for an airing. There is something interesting in the seeming contradictions of these little beings. One while you would think from their movements that they were all impulse and flash, so rapid and jerky, and in such unexpected directions, are their movements. There is so much circumspection in those eyes — a literal looking around things from which one might infer deliberation in every act. Whatever may be the preliminary thinking, the execution is all impulse, flash, and dash. Still, there is one notable exception to all this. It is in the matter of undressing himself, an operation which comes off several times in the season. Nothing can possibly be more deliberate. Previous to the undertaking it looks much as did Patrick's parrot when thinking intently on nothing, although with Anolis there is real head-work going on. In fact, its head is actually turning gray, yes, almost white. There is a serious corrugation of the scalp, then a splitting of the cuticle. It now rubs the head against one of the posts at the corners, thus pushing the skin back on to the neck, on both sides of which the loosened cuticle stands out like a flange, or stiff collar of extravagant proportions. As the sunlight shines through, it has a decided hue, namely, the pale blue of tempered steel, which by a trick of the trade is so exaggeratingly imitated by painting on certain steel implements, as axes and scythe blades. So the creature sits in the sunlight, forcing upon us the most ludicrous associations by its great stand-up collar. We are reminded of the vain servant on his Sunday parole, with collar broad and reaching to the ears, stiffly starched and overblued. "Massy on us, Julius!" said his fellow-servant, "if you should fall down atween dose new scy' blades, you permit suicide, most sartin!" In the sunlight this ragged cuticle is ex-former beauty: a delicate pale translucent blue; and the scale markings so minute as to suggest a lace work that is too fine for the execution of any loom. But to Anolis all this is "gauzy frippery" now, and its presence irksome. A few more rubs and pushes, and in a ragged condition it is got back to the thighs. The persistent creature now succeeds in so flexing its head as to get it flat sidewise on its neck, when it seizes the ragged edge of the old garment with its teeth. There is some tugging, followed by one or two tumbles over, when off comes a large piece of the vestment. What then? It is swallowed! Then the head and neck and one front limb are denuded. It turns now to the other front limb, on the upper part of which is a piece of loose skin flaring most prominently. Just then a fly approaches provokingly near. With one boot on and one boot off, Anolis makes for that dipteran disturber of his private labors. The fly serves as a luncheon, which disposed of, the lizard resumes its work, and the sharp nose dips into the old clothes again. Anolis is not long in getting off the skin. It is all done piecemeal as just described, and every particle is eaten; even the bits that fall between the plants are carefully picked up. There are several sheddings in one summer. This lizard, I think, has gone through it four or five times this season. Under the microscope a bit of the old cuticle is a beautiful object. This exuvia is the exact mold or impression of the scaly skin which it has left behind. Of course, then, one side of this cast consists of depressions, the other side of elevations, which correspond precisely. Under a quarter-inch objective lens the elevated side is surprisingly like a lot of white peaches spread uniformly on a table. Not truly convex, but gibbous is each elevation, being a little longer than broad. Each has a dark curved line extending nearly its entire length. This line is curiously suggestive of the depression which separates at one side the two cheeks of a peach. Each line begins at the base end of the scale, which corresponds to the stem end of the fruit. Here the line is the widest, when it narrows gently, until it disappears a little before reaching the opposite end of the cast, or, to continue the simile, the flower end of the fruit. At this point the peach similitude stops; for the entire gibbous surface is closely dotted with polygons or several-sided spots. Although not at all regular, yet the sides of these markings are very distinct, and quite easily counted, each having four, five, or six bounding lines; or, since M. Martinet insists on the hard words, these figures are composed of irregular rectangles or parallelograms, pentagons, and hexagons. No two of these round prominences, or peach-shaped scale-casts, touch each other. Themselves of a silvery hue, they are separated from one another by a thicker cuticle, of a much darker color, thus throwing out the rounded casts in bold relief.

And what is the philosophy of their swallowing this cast-off skin? I have seen that pretty newt, the *Triton millepunctata*, exuviate beneath the water. Except the rent made at the head, which is the starting-point of exuviation, the divested skin was entire, even to the very toes, and appeared in the water a gossamer likeness of the animal itself. As soon as it moulted, the little thing would turn round and swallow its cast-off garment, tucking it in entire and untorn. The toad does the very same thing. There must be, I think, some vital economy which is subserved by this singular habit of putting up the old clothes, or, as our juvenile wag suggests, turning the stomach into a clothes-chest. Motive in this matter can hardly be attributed to things so lowly. We are reminded of a somewhat similar habit, and quite as strange, of the educabilia, or higher animals. Dogs, cats, cows, etc., devour their own placenta. The mother dog and cat keep the bed of their litter clean by swallowing the excreta. Our little "Lady," a high-bred diminutive hound, had lately two pups. One died in the night. Her mistress was shocked next morning at finding Lady devouring her dead baby. All had disappeared but the head, when her strange work was arrested. And so cleanly was the whole business, not a stain was on her blanket. Now these animals have no cannibal propensities. Recently a cheetah, the Persian hunting leopard (*Leoparda jubata*), having died suddenly, came into our possession. The animal was in such excellent condition, its flesh so fat and tender, that we offered some choice cuts to a number of dogs, Lady being among them. It was really curious to observe their conduct. They stretched their necks, bringing their noses near enough to smell, but not to touch the strange meat; which done, each turned away in solid disgust. Here gleamed the true nobleness of these educabilia, a proper sense of the fitness of things. Nature hath her mysterious sanctities, and even in the animal reckoning, such matters should be promptly put out of sight.

Anolis can cleave to the glass. The phenomena is precisely, as I understand it, the same as with the sucking disk of the shark-sucker, *Echeneis remora*. With a hand-lens I have watched its toes while adhering to the glass. The flattened pads are as dry [illegible] but [illegible] are transverse, each one as long as the [illegible] erectile, too. Now when the animal [illegible] to adhere to it, these scales are shut [illegible] all closed. At the precise instant of [illegible] which terminates the leap, these trans- [illegible] set on edge; thus there are as many [illegible] so many transverse pits; and every one [illegible] mechanism just described, of necessity a [illegible] five toes on each foot are serviceable in [illegible] pads of the toes vary much in size, so [illegible] transverse scales. They run from about [illegible] an average of twenty-five for each [illegible] sixteen, there would be not less than four [illegible] pits, or air-exhausted depressions.

[illegible] the chief interest in this little so-called [illegible] attaches to its faculty of changing its color at [illegible] of color are a deep, warm, bronzy brown, [illegible] pea-green. Throughout the summer, espe- [illegible] favorite position of our Anolis was to hang [illegible] from the posts at the corners of the [illegible] they invariably spent the night. It was [illegible] for sleep. How often have I taken the [illegible] case at different hours of the night, [illegible] tightly closed and fast asleep, and their [illegible] But the posts to which they thus adhered [illegible] deep brown color, hence the two colors [illegible] Throughout the day, although oc- [illegible] diverse colors, they were for the most [illegible] although walking or nestling among the [illegible] that the color of the contiguous ob- [illegible] sake of protection is, I think, not con- [illegible] facts. The truth is that in this matter of [illegible] is a higher law than that of mere in- [illegible] law of spontaneous expression, which [illegible] to wit, that a joy unuttered is a [illegible] green be the favorite night-gown [illegible] I timidly venture the suggestion that [illegible] itself for the luxury of sleep, [illegible] utterances of its emotions. In these [illegible] remarkable agility with an equally [illegible] in sleep, and they delight in [illegible] great deal of both. But they are very easily tired, and are often seen panting from excessive exercise. Whether it be the expression of enjoyment of repose, comfort, or emotional joy, the highest manifestation is its display of green. Just listen to what I have this day witnessed. Yesterday was quite cold. The fern case was in the window, and a fire was in the room. Still the air was keen and raw. But to-day the atmosphere is mild, and the sun, full upon the window, pours his mellow warmth directly into the fern case. After putting his head forth to inspect the weather, he comes out of his troglodyte chamber, and stretches his brown body in the full blaze of the sun. What a blessed basking this is. To him, in contrast with his cave, it is the luxury of bliss. Nolie soon begins to doze, sleepily opening and shutting his eyes, but keeping both auricles open wide. Now begins that wonderful play of colors. It appears first in the normal bronze brown of the back. Literally they are lively colors, such are the moving changes, as the folds of the skin, especially those on the neck, catch and glance the sunlight. That deep umber is now mellowing into a yellowish brown. A minute more and it has a bronze, coppery tint. Now it runs into an olive-green; anon, a leek-green; at last a pale but bright pea-green. Through all this color transformation on the back there is a medial line extending from the head to the tail, which is always of a hue paler than all the rest. As to the under parts, the customary ashiness is all gone. It is white; but such a white; not glaring, but soft. In fact, I think the tiny scales are now set a little on edge, thus giving the white the aspect of frosted silver. The back, as was said, is green; but I now observe what I have very seldom seen, that, so to speak, over this green is a bloom, so that it looks like a frosted green. It is observable that the top of the flat head doggedly retains its dark normal brown. As to the eyelids, in this matter of color, I think they are the most to be admired. Each of these little brilliant orbs in constant motion is a perpetual twinkle. In ordinary repose the eyelids are a pretty, pale brown. But these organs are especially susceptible of color-change. Not only will they run rapidly through the whole scale, but the positive colors will be spread in such decided and rapid contrast that it seems as if the order were set to the key-note of a humor which "is alone high fantastical." These winking lids emulate the gems. Now, a palish brown, they are smoky topazes. Instantly they become green emeralds, and quicker than one can write flash into the peculiar blue of the turquoise. I have seen the New York stickleback (*Gasterosteus Noveboracensis*), in its love season, go through changes as bright and rapid; yes, even the gray, cold pupil of its eye would flash into the true blue of heaven. The eye of our Anolis cannot do this. Its colors are fixed. But what a pretty eye it has. The pupil is as the most sparkling jet, and the iris is a ring of limpid amber. But as to these color-changes, it should be borne in mind that they are excited by causes the very opposite in character, love and hate, for they can woo and fight too; also by fear and joy. In the changes just described, I see the manifestation of animal enjoyment. It is Nolie's way of telling it, — his conventional, "I feel good." So dumb is he that this is his only way of getting it out. Only once have I heard any semblance to sound escape him. I had thrown a half-crippled fly at him, which struck on his nose. He let off just the tiniest "umph!" then caught the fly and disposed of it.

The sun has gone down behind yonder house. Nolie knows it. His bright [illegible] have left, and he betakes himself to his little [illegible].

I had forgotten to say that Nolie's two weakly comrades died within some three weeks of each other. One of them had lain for two days in the mossy bed, and was a beautiful bright green. How we did admire it for those two days, not knowing that its little life had fled. It was somewhat consoling to us all to reflect that [illegible] time had come, and it had died in a green old age. It was put into alcohol, where in a few days the green disappeared and the normal brown returned. This surprised me, as I had expected a result similar to my experience with the green snake (*[illegible] vernalis*), which in alcohol turns blue. [illegible] it should be added that it also departed this life in a suit of green.

I [illegible] a very large Anolis from Cuba. Its body was [illegible] long, and it was quite thick in proportion. [illegible] as greatly was its expansile throat, or [illegible] which it would inflate to an enormous size. This characteristic [illegible] true of our little *Anolis principalis*, and [illegible] in the books. In this regard I have been [illegible] having witnessed the phenomenon only twice [illegible] The spectacle, though strange, is very pretty. [illegible] the throat expands immensely, giving [illegible] rather formidable aspect. The colors of the [illegible] are very fine, usually ending in a perfect [illegible]

A word more must be said of those delicate markings of very dark brown, sprinkled so thickly on the back and sides. As already mentioned, they are made up of little straight lines, zigzags, and chevrons. They are as constant and perhaps as inexplicable as those queer markings on certain minerals, known as "Widmannstattian figures." These tiny markings on the back and sides of *Anolis principalis* are always there, and they never change their color. Even when Anolis has changed from a ruddy brown to a bright green, a hand-lens will show that these figures are all there, and that they have retained their brown color too. And in some way, upon close inspection, it will be seen that whatever the hue may be that is assumed, these singular figures impart to it character and tone.

I think our observations show that the highest effort in color-change is in the green. There were two instances in which it is my belief that this same color was produced involuntarily. It is observable that the Anolis delights in tints. From a deep olive it will run through the entire gamut of that color by insensible hues into a leek green. It does not like harsh color lines. Now on one occasion Nolie had a queer spot break out on his right flank, just behind the fore limb. It was a bright green patch, nearly half an inch in length. The outline was sharp and angular. It was on a cold day, when the room was uncomfortable, just the time when there is no disposition to change color. It is notable, also, that this patch of green upon that dark ground of brown held its brightness for two days, a very long period indeed. At another time, under like circumstances, a smaller patch of the same color appeared on the left flank, near the hind leg. It had the same patchiness as the former spot, and also continued bright for an unusually long time.

Perhaps a hundred times have we been asked the question, "How are these changes of color produced?" The physiology of this matter is not well understood; but there is a hypothesis upon it which is probably in the main correct. To state this in rigid accuracy would likely for some of our readers require too many technical terms. At the risk, then, of appearing to be didactic, we will use very different speech. Supposing through a sheet of block tin many thousands of little pipes were made just to enter. Let them, if you will, be regarded as infinitely small. Call this series A. Now suppose another series in all respects similar and fixed in like manner. Call this series B. It must be understood that the pipes of one series alternate with those of the other series, so that it shall be first a pipe of A, then a pipe of B, and so on in regular order for both series. Suppose again that the A pipes contain green pigment, and the B pipes contain yellow. We will further imagine that each pipe series has a series of muscles which can act upon them. Now laid over the mouths of all these pigment tubes let us suppose a translucent film. Our perforated block tin and its translucent spread, with the mouths of the color tubes opening between them, shall represent the *rete mucosum*, or colored layer of the skin. Suppose now the appropriate muscles squeeze the lower ends of the A series of pigment tubes, the pigment at once comes up against the almost transparent skin, the color of which is now blue. Let the muscles relax and the pigment descends into the tubes again. Let the same process occur with the B series of tubes, and the result will be that the skin shows a yellow color. Not waiting for the yellow pigment to return into the tubes, let the A series be again squeezed, and up comes the blue pigment against the translucent spread. Now everybody knows that a green color is easily made by a mixture of yellow and blue. Suppose the little spots where the blue touches under the translucent film to be so small as to be called molecules, and suppose the same of the spots where the yellow pigment touches, and you have all the conditions necessary for begetting green. It is also easily imagined how by regulating the amount of muscular pressure the proportions of the separate pigments is regulated, and so the most delicate tints are produced.

At the dining table of a hotel in Florida a lady appeared with her four pet Anoles. They were fastened to her head-gear by silken threads and ran over her neck and head, or nestled in the tresses of her hair, as they saw fit. In this particular we think the lady did violence to the rights of others. But duly regarding the proprieties of time and place, the lady did well in her delight with her "little chameleons." As a pet, the *Anolis principalis* is everything that is commendable: clean, inoffensive, pretty, and wonderfully entertaining; provoking harmless mirth, and stirring up in the thinker the profoundest depths of his philosophy.

THE PROPER SPECIFIC NAME OF THE SONG SPARROW.[1]

BY DAVID SCOTT.

IT appears that this common little bird has been known for over a half century by a specific name which, if the just rule of priority is considered, cannot be applied to it longer.

The observation of a specimen which presented a rather unique appearance — the tail being veined by transverse dark brown bars, quite sharply defined — discovered the fact to me.

Recent examination of numerous specimens shows that this feature is more or less apparent in nearly all examples. It seems, however, to have been unnoticed since Pennant wrote until the obtaining of my specimen, which was some two years ago, for no author in his description of the bird has shown an acquaintance with the peculiarity; but quite the reverse, as Professor Baird distinctly affirms[2] that the tail of the song sparrow displays no such appearance as the following descriptions would imply.

Pennant's description is: With the crown, hind part of neck, and back rust colored, spotted with black; the spots on the back large; coverts of the wing plain ferruginous; primaries dusky, edged with dirty-white; whole under side white, with black streaks pointing downwards; tail brown, crossed by numerous dusky bars. Inhabits New York. (Arctic Zoölogy, ii. 375.)

Gmelin writes: Fringilla ferruginea nigro-maculata, subtus alba nigro-striata, alis ferrugineis, cauda fusca atrolineata. Habitat in Noveboraco. (Systema Naturæ, i. 922.)

Who can doubt but that these descriptions refer to the song sparrow, if they do differ in a few minor respects?

We think it follows from the above citation from Pennant that our song sparrow was the bird he had in hand when he penned his portrayal and suggested the name "fasciated sparrow" (upon which Gmelin's name is founded); moreover, as the latter author's name antedates the one assigned by Wilson, it follows, therefore, that *fasciata* should take precedence, to the elimination of "*melodia.*"

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[1] MELOSPIZA FASCIATA.

Fasciated Finch Pennant, Arct. Zoöl., ii. 375.

Fringilla fasciata Gmelin, Syst. Nat., i. 1788, 922. — Latham, Index Orn., i. 1790, 445. — Nuttall, Man. Orn., i. 2d ed. 1840, 562.

Fringilla melodia Wilson, Am. Orn., ii. 1810, 125. — Licht., Verz., 1823, No. 249. — Aud., Orn. Biog., i. 1832, 126; v. 507. — Ib., Syn., 1839, 120. — Ib., Birds Am., iii 1841, 147. — Max., Cab. Jour., vi. 1858, 275.

Zonotrichia melodia Bon., List, 1838. — Ib., Conspectus, 1850, 478.

Melospiza melodia Baird, Birds N. Am., 1858, 477. — Coues, Key, 1872, 139. — Baird, Brewer and Ridgway, Hist. N. Am. Birds, ii. 1874, 19.

Melospiza fasciata Scott.

[2] "The fasciated sparrow of Pennant, Arctic Zoöl., ii. 375, upon which Gmelin's name is based, answers pretty well for our species, but the tail is said to be crossed by numerous dusky bars, which is not the case with *melodia*." — Foot-note, Pacific Rail Road Reports, ix. 1858, p. 477.

It may be urged, however, that *fasciata* is not entirely appropriate, and *melodia* having been recognized as the correct name so long, a change is unnecessary; and that if this work of restoration begins there will have to be many other changes in ornithological nomenclature. But we say, Let it begin; let all the old names that can lay claim to restoration, and be recognized as applying to present species, be brought to light and receive due consideration.

The *Chamæa fasciata* Gambel furnishes a parallel case with the song sparrow in the possession of a barred tail; and the bars are no more appreciable, in fact less so, than in some individuals of the *Melospiza.*

Now, if this name is currently recognized as applicable to the *Chamæa*, with its distinctive feature less marked than in *Melospiza*, why should it not hold good with the latter?

In the Smithsonian collection are specimens of the western varieties—*fallax*, *rufina*, *guttata*, *Gouldi*, and *Heermanni*—which possess quite visibly barred tails.

NEW ZEALAND FLAX.

BY J. C. RUSSELL.

THE attention of the traveler who stands for the first time on the shores of New Zealand is especially attracted by two characteristics of its flora, one or the other of which will be present in every scene that impresses itself on his memory.

The first is the profusion everywhere of ferns of many different forms and colors, which present every gradation, from the strange and graceful tree-ferns, which raise their spreading crowns of feathery fronds thirty or forty feet from the ground, down to the little bright green ferns, with fronds scarcely half an inch long, which cling to the rocks far below in the dark ravines, where they are constantly wet with spray.

The other plant which especially calls for his examination, and which is the subject of our sketch, is a flag-like, liliaceous plant, growing in large spreading clusters of sword-shaped leaves, which are often eight or ten feet in length, and of a bright, shining green color. Many of these bunches support an upright flower-stalk, with purple blossoms, which resembles, somewhat, the inflorescence of the banana, held in an upright position. This plant is known to the colonists as New Zealand flax, and to the botanist as *Phormium tenax*, of which several varieties have been described.

It is very characteristic of New Zealand, being found nowhere else, except on the Norfolk and Chatham Islands.

During our stay in New Zealand we found it growing wherever we went, from the low shores of the southern part of the South Island, where it covers immense fields, up to an elevation of four and five thousand feet among the southern Alps.

The spreading masses of Phormium growing among thick groves of the palm-like grass-tree (*Cordyline australis*) give to many retired nooks and valleys a soft tropical beauty, that forms a pleasing contrast with the usual rugged and Alpine grandeur of New Zealand scenery.

The New Zealand flax covers thousands of acres, both in the North and South Island; this amount, although vast, could be increased many fold by cultivation. Seemingly, it likes best the low, wet land near the coast, but also grows with great luxuriance along the banks of rivers and lakes, where it can obtain plenty of moisture.

To the natives of New Zealand, before the blessings of civilization (?) were thrust upon them, the Phormium was what the cocoa-nut palm is to the inhabitants of the tropics, or the bamboo to the Hindoo and Malay. The Maori woman, sitting on the earthen floor of her hut, makes an incision across a leaf of Phormium with the sharp edge of a mussel-shell; then placing the leaf on the edge of the shell, with the cut side up, rapidly draws it between her thumb and the shell, thus stripping off the green pulp, and leaving the tough fibre ready for use.

Of this the Maoris weave their mats and rugs, which are very soft and warm, and often wrought in an elegant pattern by means of colored Phormium.

These mats, together with garments made of the dried, undressed leaves, formed the scanty clothing of the natives before the coming of the Europeans.

The dried leaves, when split into narrow strips, are used to make coarse matting for the floor, and baskets to contain fruit and serve as dishes.

The long, tough fibre is made into strong nets and fishing-lines, and is also of great use in building houses, canoes, etc.

The stone adzes with which the Maoris dug out and ornamented their canoes were lashed to wooden handles by bands of Phormium, which also furnished the canoe with sails.

The clear white gum that exudes from the base of the leaves is used as glue and also for chewing; with the colonists it forms an excellent substitute for mucilage and sealing-wax.

The bright-eyed Maori boy makes his toy canoe of the green leaves, and gathers the sweet honey from the blossoms of the Phormium.

At the present day the more enlightened natives use it instead of writing-paper, and "with a sharp-edged shell engrave their thoughts upon it."

One night while spearing the monstrous eels that inhabit the New Zealand lakes, we became acquainted with another of the uses of this interesting plant; the old dead leaves, when bound into small bundles, made excellent torches, which answered our purpose nearly as well as pine knots, with the use of which most of us are familiar.

These are a few of the purposes for which Phormium is used by the simple New Zealander.

To civilized man it would become a hundred-fold more useful, could he but invent a cheap and satisfactory method of cleaning the fibre.

This fibre has been found by experiment to be the strongest known, with the exception of silk, being twice as tenacious as common hemp.

Numerous machines have been invented to meet this want, but as yet none have been a success.

Could such a method be devised, this strong and beautiful fibre would compete favorably with the manilla of the Philippine Islands, or the flax and hemp of Europe and America.

Such a discovery would bring to New Zealand greater wealth than she has derived from her gold mines, and, together with the immense amount of wool that is annually shipped from her shores, make those rich islands eminently a fibre-producing country.

With the imperfect means at their command the colonists have already produced considerable quantities of dressed Phormium. This, in former years, was small in quantity, but of an excellent quality, being prepared by the Maoris. In 1870, there was sold in the London market four thousand tons of Phormium fibre; this, however, was of an inferior quality, having been imperfectly prepared by machines. Its principal use is, at present, in the manufacture of ropes, for which purpose it is usually mixed with manilla. Numerous chemical means have been resorted to for obtaining the fibre, but without satisfactory results. Thus far civilized man, with all his array of machines and engines, has been unable to do the simple work of cleaning the Phormium fibre as well as the tattooed cannibal did with a sea-shell.

THE AVAILABILITY OF CERTAIN BARTRAMIAN NAMES IN ORNITHOLOGY.

BY J. A. ALLEN.

UNDER the caption "Fasti Ornithologiæ Redivivi.—No. I. Bartram's Travel's," Dr. Elliott Coues has recently[1] attempted to revive sundry of Bartram's names of the birds of the United States, on the ground of their priority. Dr. Coues assumes that Bartram was "on principle binomial, occasionally lapsing;" and that "if his occasional slips are to count against him, then not a few great modern ornithologists must also be ruled out; among whom may be instanced Schlegel, Bonaparte, Sundevall, and others, in whose writings are found trinomial names," etc. "But the count against him [Bartram] for nearly a century," says Dr. Coues, "is not a true bill; the verdict must be, if not reversed, radically modified." Since a few of Bartram's binomial names have come into current use, whilst others are commonly cited in synonymical lists, Dr. Coues claims that if Bartram is entitled to anything, he has not received what is rightfully his due, and if not entitled to anything we have given him tribute to which he has no claim. Dr. Coues adopts the former alternative, and on the ground of consistency advocates the adoption of all of Bartram's binomial names that can be identified, in cases where they happen to have priority, whether they are accompanied by descriptions or not.

Before accepting fully the results that follow such premises, let us examine a little into the nature of Bartram's work. The ornithological matter contained in Bartram's Travels is notably of two kinds. In the general narrative he has at sundry places described not only the habits and distribution of some of the birds he met with in his travels, but has given more or less careful descriptions of the birds themselves, designating them also by binomial names. In addition to this he has given, at pages 288–296, a nominal list of two hundred and fifteen species, in which he has usually mentioned the species under Latin binomial names, to which he has added an English name; occasionally to the Latin names he has appended a few words of description, also in Latin; while certain typographical signs are prefixed to denote the places of residence of the different species and their migrations. These signs, with the simple names, constitute in most cases all that approaches to a description of the species that Bartram has given; yet the attempt is now made to establish priority for these names, on the ground that the species thus designated were sufficiently described to substantiate the claim, and to set them up in place of names backed by good description and thoroughly familiar through long use.

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[1] Proc. Acad. Nat. Sci., Phila., 1875, pp. 338–358, September, 1875.

In this list of two hundred and fifteen species, quite a number of names prove to be synonymous with others; thirty-six are given by Dr. Coues as "undetermined," and ten or a dozen more are only guessed at; leaving fully one fifth of the whole number almost hopelessly in doubt. In addition to this there are thirty-five or more *polynomial* names. Of the one hundred and eighty species of the names of which Dr. Coues attempts to give the present equivalents, nearly all had been previously described in the Systema Naturæ of Linnæus, a work that must have been accessible to Bartram if any European book on natural history could be; and that it was so is evident from his references to it in the botanical portions of his work. Bartram has, in fact, in some groups employed a large proportion of Linnæan names, while in others he has either altogether ignored them or was ignorant of them. Of his twenty-two species of rapacious birds, all but three of the recognizable species were already in the Systema Naturæ, yet only *five* of them appear under the Linnæan names; of his seventeen remaining names only *one*, *Vultur atratus*, is strictly entitled to recognition. Of the rest of the land birds, numbering one hundred and seven species, a dozen of the names are either polynomial, synonyms, or undeterminable, while of the remaining ninety-five, eighty of the species had been previously named and described in the Systema Naturæ, or by other writers preceding Bartram; yet less than half of these names were used by Bartram, who instead gave new names of his own. In the rest of the list, embracing the wading and swimming birds, the case is even still worse. Of these, numbering eighty-five species, nineteen are given by Dr. Coues as "undetermined;" fifteen others are guessed at only, three are synonyms, and fifteen of the names are polynomial! Of the thirty-three binomially named species determined by Dr. Coues, twenty-eight had been described in the Systema Naturæ; of the remaining five, Dr. Coues regards three as available. Finally it appears that after excluding from Bartram's list of two hundred and fifteen species the synonyms, the polynomial names, and the undeterminable ones, we have left but one hundred and forty-six, or about two thirds of the whole; and that of these one hundred and thirty, or thereabouts, had been named and described several years prior to the publication of Bartram's work, mainly, too, in the Systema Naturæ, a book that to Bartram must have been one of the most accessible works on natural history.

Dr. Coues, however, has indicated twenty Bartramian specific names and one generic name which he claims must be adopted, in order that Bartram may have his due as one of the fathers of American ornithology. We are, of course, not to judge the scientific works of a century ago by our present standards, but making due allowance for the two periods, it would seem that in the recognition Bartram has already had, he has been most fairly dealt with, and that further claims for him will only call forth a more rigid criticism of his merits as an ornithological writer than his work will well bear. Ten of these twenty-one Bartramian names, however, Dr. Coues claims, have been for a long time currently in use, six of them having been "erroneously" attributed to Wilson and one to Audubon. The remaining ten Dr. Coues proceeds to newly "set up."

But let us examine Bartram's work still further. First, respecting Bartram as a binomialist: we find that out of two hundred and fifteen names in his list thirty-six are not binomial, or more than *one in seven*, — pretty frequent lapses for a "binomialist on principle." Secondly, we find that the Bartramian names already in current use or quoted as synonyms belong to species that he not only binomially named, but to species which he more or less fully described in his narrative, though some, it is true, are taken from among those of his list. Thirdly, it seems that the species for which Bartramian names have been currently employed, but "incorrectly" attributed to Wilson or

Audubon, were never described, in any true sense, by Bartram, and would be undeterminable if their recognition depended on anything in Bartram's work. We have in nearly every case only the name, which, being a characteristic one, is presumably referable to the species to which it was subsequently applied by Wilson or Audubon, who were the first to give anything which, by any reasonable license, can be construed as a "description" of the species in question. In most cases Wilson may have obtained the names directly from Bartram, since, as is well-known, William Bartram was not only the friend of Wilson, but his associate and instructor in natural history; and it is hardly presumable that Wilson did not know, through personal intercourse with Bartram, the birds the latter had named in his Travels.[1] Besides this, the natural applicability of the names to the species in question may have rendered the names in a measure traditionally current. Other names which have not that happy suggestiveness, but which are in all other respects wholly parallel, figure prominently in the long list of Bartram's species that Dr. Coues, with all his ability as an ornithological expert, has had to give as "undetermined." The specific name *palustris*, when applied to a sparrow or a wren, may be distinctive when it happens that only one species of the group to which the species belongs affects marshy situations, but as soon as a second is found, the name of course has then no distinctive value. Coincidences of this kind are all that make *many* of Bartram's names determinable; and this merely chanced to be so, happening otherwise, however, in numerous instances, as witness the in other respects parallel cases of "*Falco pullarius*, the chicken hawk," "*F. gallinarius*, the hen hawk," "*Fringilla canabina*, the hemp bird," "*Calandra pratensis*, the May bird," etc. Fourthly, the remarks above given under "thirdly" are also strictly applicable to nearly all of the Bartramian names newly set up by Dr. Coues, these being determinable only by negative evidence and not by anything inherent in Bartram's work, — simply through a process of exclusion by virtue of a full knowledge of the avi-fauna of the region in question; by knowing that they cannot well refer to anything else. For nearly or quite half a century after Bartram wrote, such a thing would have been impossible, simply from lack of this necessary knowledge of the fauna of the region to which Bartram's work refers.

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[1] In the case of Audubon, the single instance of the use of the same name may perhaps be properly regarded as a coincidence.

Lists like Bartram's are not of rare occurrence, where the authors, not having the means of readily determining the species, or not caring to take the trouble to do so, give the correct names when they happen to know them, and prefer coining names for the others as the easiest way out of a difficulty.

Finally, let me ask students of zoölogy — for the principle involved is not, of course, limited to ornithology — if searching for old names, which, like those of Bartram's, can only be determined by the process of exclusion, with which to supplant long-established ones, intelligently proposed and backed by adequate descriptions, tends to the best interest of science? If the example Dr. Coues is here setting is to be followed, there will be no stability to our nomenclature for a long time, but only, except perhaps to a few experts, the most perplexing confusion. The advocacy of such revolutions on the score of *justice* is, it seems to me, calling things by wrong names, robbing, as it does, intelligent workers of the recognition justly their due, whenever circumstance may favor the deciphering of the hieroglyphics of earlier slovenly or ignorant writers, of which their own works would never afford an interpretation. Such researches may be of interest from an antiquarian point of view, but they should end with their legitimate results, and not be pushed with a view of overturning long-settled names in zoölogical nomenclature. I herewith append a list of the Bartramian names (given in quotation marks) which Dr. Coues wishes to see set up, with the nomenclature resulting from his determinations, together with their usual equivalents, and with a few critical remarks on special points.

1. "VULTUR ATRATUS, black vulture or carrion crow" = *Carthartes atratus* (Bartr.). Elsewhere well described.

2. "FALCO GLAUCUS, the sharp-winged hawk, of a pale sky-blue color, the tip of the wings black" = *Elanus glaucus* (Bartr.) Coues = *E. leucurus* auct. Otherwise further described.

3. "FALCO SUBCERULIUS, the sharp-winged hawk, of a dusky blue color" = *Ictinia subcæruleus* (Bartr.) Coues = *I. Mississippiensis* auct. Otherwise further described.

4. "CORVUS CARNIVORUS, the raven" = *Corvus corax*, var. *carnivorus* (Bartr.) B. B. and R. Adopted in 1858 by Baird, but Bartram's whole description consists of the names here given in quotation marks, with a mark prefixed denoting that it is one of the species that "arrive in Pennsylvania in the *spring* season, from the *South*, which, after building nests and rearing their young, return again *southerly* in the *autumn*." At page

179 Bartram speaks of seeing "the vultures and *ravens* crouched on the crooked limbs of the lofty pines," etc., in East Florida. Is Dr. Coues willing to extend the former range of the raven over East Florida, and admit it as a *summer migrant from the South* to Pennsylvania, accepting Bartram as authority, and amend his ornithological writings to correspond? Consistency certainly calls for this if we adopt Bartram's name, and "consistency is a jewel," says our author.

5. "CORVUS MARITIMUS, the great sea-side crow or rook" = *Corvus maritimus* Bartr. = *C. ossifragus* Wils. Based on the name and the indication of its habitat, though "great," as compared with the others, is erroneous. The ambiguity that overshadows *C. carnivorus* throws additional doubt upon the identity of *C. maritimus* with *C. ossifragus.*

6. "CORVUS FRUGIVORUS, the common crow" = *C. frugivorus* Bartr. = *C. Americanus* Aud. Based on the name alone and "exactly parallel," says Dr. Coues, with the case of the raven.

7. "CORVUS FLORIDANUS, pica glandaria minor, the little jay of Florida" = *Cyanocitta Floridana* (Bartr.) Bon. = *Aphelocoma Floridana* (Bartr.) Cab. At page 212 distinguished from *Cyanura cristata.*

8. "GRACULA PURPUREA, the lesser purple jackdaw, or crow blackbird" = *Quiscalus purpureus* (Bartr.) Cass. This rendering is evidently not tenable, since the *Gracula quiscula* of Linnæus (1758), as shown by his description in the Systema Naturæ, refers to this species and not to *Q. major*, though possibly some of the references may. Hence if *quiscula* is to be used for either of the *Quiscali*, it must be used for *purpureus* and not for *major*, although Bartram employed it for *Q. major*, and on this ground Dr. Coues suggests its adoption for that species.[1]

9. "CERTHIA RUFA, little brown variegated creeper" = *C. familiaris*, var. *rufa* (Bartr.) Coues, "with those who separate the bird from the European" = *C. Americana* auct.

10. "CERTHIA PINUS, the pine creeper" = *Dendrœca pinus* (Bartr.) Bd. "The name," says Coues, "is universally attributed to Wilson, but we see here its original source." Are we quite

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[1] "GRACULA QUISCULA, the purple jackdaw of the sea-coast" *Bartram.* Dr. Coues says, "The expression 'purple jackdaw of the sea-coast' is perfectly diagnostic, the species being thoroughly maritime and always called jackdaw in the countries it inhabits." It, however, shares the name "purple jackdaw" with *Q. purpureus,* see Catesby and subsequent early writers. "To those to whom," Dr. Coues continues, "such alliterative names as *Sialia sialis, Cupidonia cupido,* etc., are unobjectionable, I suggest the propriety of calling this species *Quiscalus quiscula.*"

sure? Is it not more likely to be the *Helminthophaga pinus*, which is the "pine creeper" of Catesby, and the *Certhia pinus* of Linnæus, since Bartram often quotes Catesby, even in his list, and many of his trinomials and English names are the same as those of Catesby, and evidently adopted from Catesby.

11. "LUCAR LIVIDUS, apice nigra, the cat bird or chicken bird" = *Lucar Carolinensis* (Bartr.) Coues = *Mimus Carolinensis* auct. Dr. Coues, presuming "apice nigra" was intended to read "vertice nigra," which of course is probable, adopts the name *Lucar*, though "probably meaningless" and looking "like a misprint," for the generic name of the cat bird, as being coequal with *Felivox* of Bonaparte and *Galeoscoptis* of Cabanis, and as equivalent to *Mimus* in case the cat bird and mocking birds are to be placed in the same genus.

12. "MELEAGRIS AMERICANUS, the wild turkey" = *Meleagris gallopavo*, var. *Americana* (Bartr.) Coues. As it is fully described at pages 14 and 83, and binomially named on page 83 as *Meleagris occidentalis*, this, if either of Bartram's names is to be adoped, is the one which, *according to the rule of priority*, *must* be adopted, *M. occidentalis* having the precedence of over two hundred pages in Bartram's work. Hence we have *Meleagris gallopavo* var. *occidentalis* (Bartr.)! The name *occidentalis* was evidently given in allusion to its being an inhabitant of the western world, as he compares it with the *Meleagris* (*Numida meleagris*) of Africa.

13. "CARDUELUS PINUS, the lesser goldfinch" = *Chrysomitris pinus* (Bartr.) Bon. First described by Wilson under the same specific name, which name, as Dr. Coues observes, has been usually attributed to the latter author. Bartram's right to priority rests solely on the Latin and English names above given, which may be *presumed* to apply to *Chrysomitris pinus* auct.

14. "PASSER DOMESTICUS, the little house sparrow or chipping bird" = *Spizella domestica* (Bartr.) Coues = *Spizella socialis* auct. This is another of the lucky cases where the name alone seems to determine the species with probable certainty.

15. "PASSER PALUSTRIS, the reed sparrow" = *Melospiza palustris* (Bartr.) Bd. First described by Wilson under the same specific name, to whom the name has heretofore been attributed, but is now transferred by Dr. Coues to Bartram, because he presumably used the name for a swamp sparrow, and because we chance to have but one!

16. "PASSER AGRESTIS, the little field sparrow" = *Spizella*

agrestis (Bartr.) Coues = *S. pusilla* auct. First described by Wilson under the specific name *pusilla*, unless it be Gmelin's *Motacilla juncorum*, as some have supposed possible. Several of our sparrows would better bear the epithet "little field sparrow" than this: as, for example, *Pooecetes gramineus* and *Coturniculus passerinus*, and also *Passerculus savanna*, unless the latter should be considered too northern for the asterisk in Bartram's list. *Spizella pusilla*, though now known as "field sparrow," is only found in fields bordered with thickets or partly overgrown with bushes.

17. "MOTACILLA DOMESTICA (*regulus rufus*), the house wren" = *Troglodytes domestica* (Bartr.) Coues = *T. aëdon* auct. Without the English name "house wren," "*Motacilla domestica*" would be wholly undeterminable.

18. "MOTACILLA PALUSTRIS (*reg. minor*) the marsh wren" = *Cistothorus palustris* (Bartr.) Bd. First *described* as *palustris* by Wilson, to whom, as Dr. Coues says, this Bartramian name has usually been attributed; but why is not Bartram's *palustris* as likely to be *Cistothorus stellaris* as anything else?

19. "ARDEA MUGITANS, the marsh bittern, or Indian hen" = *Botaurus mugitans* (Bartr.) Coues = *Botaurus lentiginosus* auct. Can the above names be allowed as a basis for priority, "the marsh bittern" being the only really descriptive part?

20. "TANTALUS PICTUS (Ephouskyka Indian), the crying bird, beautifully speckled" = *Aramus pictus* (Bartr.) Coues = *A. giganteus* auct. Elsewhere fully described.

21. "COLYMBUS FLORIDANUS, the great black cormorant of Florida, having a red beak" = *Graculus Floridanus* (Bartr.). First described by Audubon under the same specific name, probably merely by a coincidence. The "red beak" Dr. Coues explains as a lapse of memory for "red gular pouch and lores."

From the foregoing it will be seen how very slight are the claims Bartram's names have to priority over those in current use. Of the twenty-one given above, Nos. 1, 2, 3, 7, 11 (the generic name only), 12 (*occidentalis*, not *Americana*), and 20, — six or seven in all, — are the only ones that, in justice to all parties, can rightfully stand. One (No. 10) has been shown to be almost unquestionably Linnæan, not Bartramian.

In conclusion, I would suggest to the author of the article under review, who seems so zealous in the vindication of a truly sagacious naturalist, the propriety of also claiming for him priority in the discovery of the geographical law of variation in size in North

American mammals, — a law it took naturalists fifty years longer to develop and formulate, — since Bartram repeatedly alludes to the smaller size of animals of the same species in Georgia and Florida than in Pennsylvania, especially the wolves, deer, foxes, "and other animals." At page 216 of his Travels, for instance, after referring to the small size of the horses of Florida, he says, "It is a matter of conjecture and inquiry, whether or not the different soil and situation of the country may have contributed in some measure in forming and establishing the difference in size and other qualities betwixt them. I have observed the horses and other animals in the high hilly country of Carolina, Georgia, Virginia, and all along our shores, are much larger and stronger than those bred in the flat country next the sea-coast; a buckskin of the Upper Creeks and Cherokees will weigh twice as heavy as those of the Siminoles or Lower Creeks, and those bred in the low flat country of Carolina."

THE HARVARD SUMMER SCHOOL OF GEOLOGY.

BY PROFESSOR N. S. SHALER.

THE first session of this, the last to be established of the several schools for summer teaching which have been originated by the officers of Harvard University, held its first session at Cumberland Gap, Kentucky, during the past summer. The design was to give practical field instruction in geology to teachers and others of some training in science and general culture, who might desire to acquire the methods of such work. The Governor of Kentucky having given an invitation to the President of Harvard College to place the school in Kentucky, and having offered the coöperation of the Kentucky Geological Survey, the school was established at Cumberland Gap, within the State of Kentucky but near to the state lines of Tennessee and Virginia. Though remote from the routes of travel, this point offered peculiar advantages for the study of stratigraphic, topographical, and dynamic geology. The structure of the Appalachian mountain system is exceedingly well shown at this point; the section extends from the lower Potsdam sandstone to the middle coal measures, giving about twelve thousand feet of beds within forty miles of distance; a wonderful system of faults of different ages bring these beds to view at many different points and enable the student to observe them under varied conditions; a short distance away, within plain tains, as the great Unaka chain, where are found the highest peaks in eastern North America. The rocks are generally rich in fossils, the section, taking it altogether, giving a peculiarly good illustration of the life of the American palæozoic rocks. The subcarboniferous and Upper Cambrian limestones being very massive, afford a remarkable series of caverns, some of great extent and many abounding in human remains.

Despite a season of great and unprecedented rain-fall, nearly thirty inches in two months, there was no serious illness in the camp.

Restrictions were put on the number of students, more applications having been rejected than accepted. The class in attendance numbered thirty-one persons, more than half of whom were teachers engaged in science-instruction in various academies, normal schools and colleges in different parts of the country.

The instruction consisted of lectures and practical work in the field, the latter occupying by far the larger part of the time. The routine of work was about as follows: at six A. M. a lecture and discussion on the last field work; another lecture in the evening, generally on some zoölogical subject. The daylight was used in field-work near camp, except by those who were out on larger excursions; two or three of the excursions, each occupying from two to four days, were made each week; parties of from four to twelve, with one or more instructors, made a foot journey together over a section of the neighboring field. Each party had a wagon or pack mule, according to the country, and an outfit of provisions and camp utensils for rough camping. On its return the party was expected to report the results of its work at one of the evening meetings. Most of the students made great progress in the field-work, some of them being brought to the point of making extended journeys, from which they would bring back well-digested reports, without the guidance of an instructor.

The following gentlemen were engaged in the administration and instruction of the school: Mr. N. S. Shaler, Professor of Palæontology of Harvard University, and Director of the Kentucky Geological Survey; Mr. Walter Faxon, Instructor in Zoölogy of Harvard University; Messrs. Lucian Carr, A. R. Crandall, F. N. Moore, W. B. Page, C. J. Norwood, John H. Talbutt, and John R. Proctor, Assistants in the Kentucky Geological Survey. Professors Safford and Kerr, State Geologists of North Carolina and Tennessee respectively, assisted in the instruction either in the camp or in the field. Professor Jordan, of Northwestern University, Indianapolis, Indiana, gave some instruction in ichthyology. Near the close of the work, in the latter part of August, several parties were organized to afford the students the opportunity of making extended journeys in the direction of their homes. One or these parties made a journey of two weeks and another of four weeks through the mountains of eastern Kentucky and Virginia. Professor Kerr accompanied a party through a part of the mountains of North Carolina.

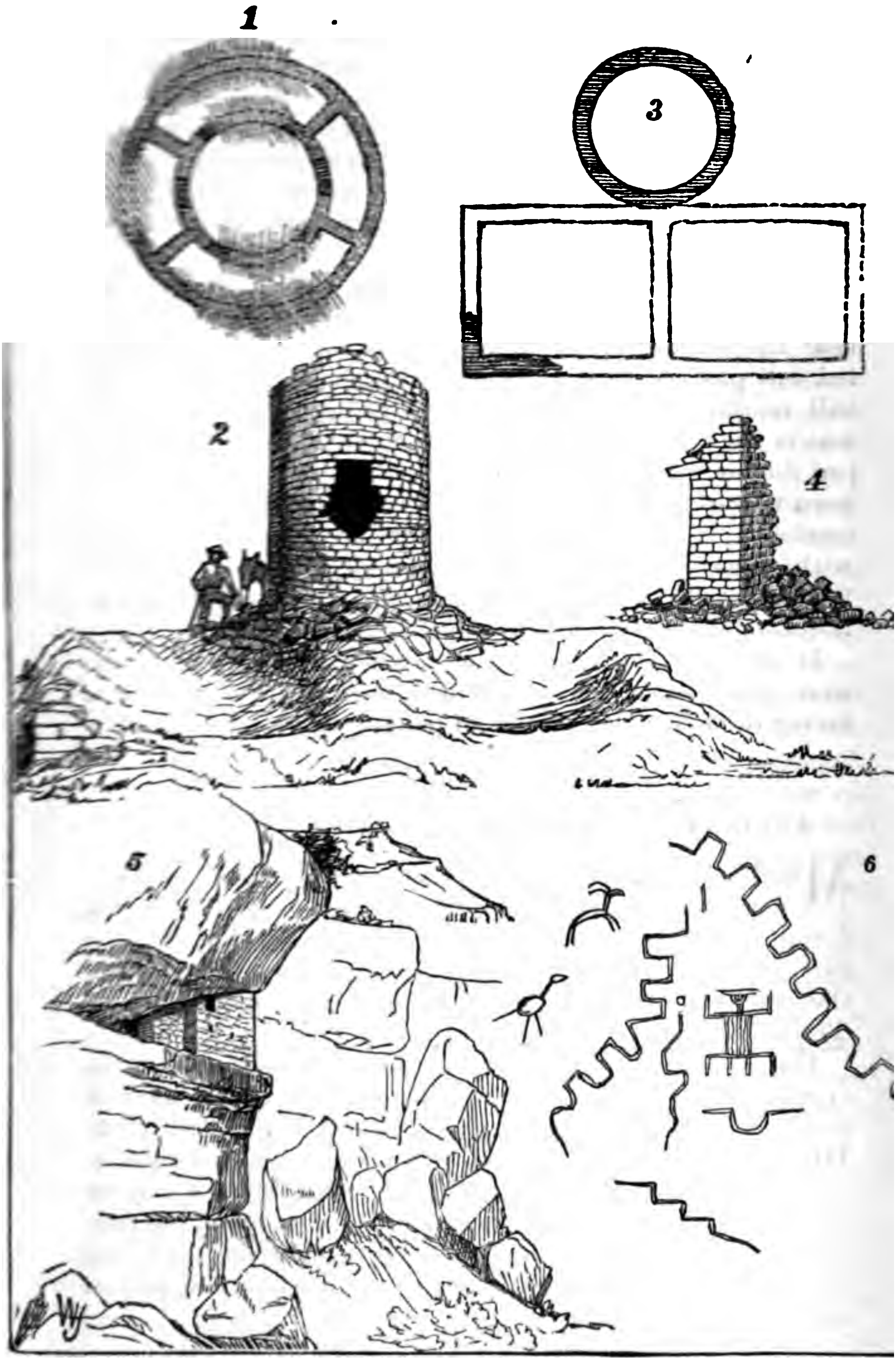
The instruction of the camp began July 1st and closed August 30th. It is proposed to hold the next session of the school at or near the same point, in 1876. The number of students admitted will probably be increased to fifty, and the other conditions will remain the same. The eminent success of the experiment was in the main due to the coöperation of the Kentucky Geological Survey. This survey furnished six skilled persons, who had been trained in the study of the rocks of the State, to the list of teachers. It is satisfactory to note that this assistance was given without any detriment to the researches of the survey, it being found that the students were a help rather than a hindrance to the work of the assistants.

It should be noted that the class was limited to persons who were graduates, or who were actually engaged in teaching or in fitting themselves for the work of professional geologists.

ANCIENT RUINS IN SOUTHWESTERN COLORADO.

MR. W. H. JACKSON, the photographer to Professor Hayden's United States Geological Survey of the Territories, describes and figures in the Bulletin (second series, No. 1) of the survey certain ancient ruins of Indian structures discovered in the valleys and gorges of the extreme southern corner of Colorado Territory.

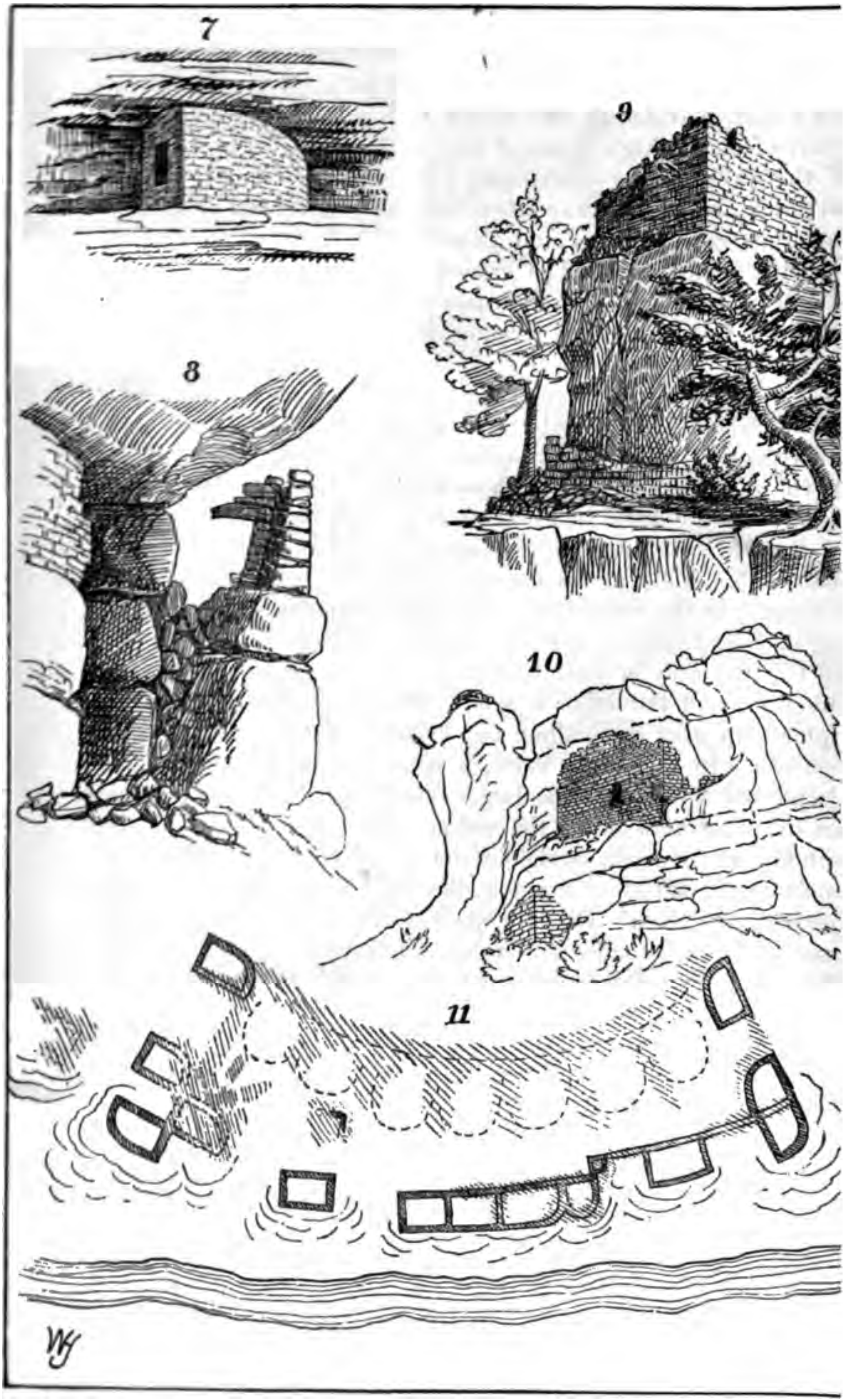
One of the most perfect houses seen was discovered in the crevices of the escarpment of the Mancos Cañon, eight hundred feet vertically above the stream at its bottom. This house (Plate III., Fig. 12; this and plates I. and II. were kindly loaned by Professor Hayden) is two storied, and remarkable, not only on account of its elevated and almost inaccessible position, but from the pains with which it was built, the walls having been constructed of carefully dressed stone, plastered within and painted in two colors.



ANCIENT RUINS IN COLORADO.

"The house itself, perched up in its little crevice like a swallow's nest, consisted of two stories, with a total height of about twelve feet, leaving a space of two or three feet between the top of the walls and the overhanging rock. We could not determine satisfactorily whether any other roof had ever existed or whether the walls ran up higher and joined the rock, but we incline to the first supposition. The ground plan showed a front room about six by nine feet in dimensions, and back of it two smaller ones, the face of the rock forming their back walls. These were each about five by seven feet square. The left hand of the two back rooms projected beyond the front room in an L. The cedar beams, which had divided the house into two floors, were gone, with the exception of a few splintered pieces and ends remaining in the wall, just enough to show what they were made of. We had some little doubt as to whether the back rooms were divided in the same way, nothing remaining to prove the fact excepting holes in the walls, at the same height as the beams in the other portion. In the lower front room were two apertures, one serving as a door and opening out upon the esplanade, about twenty by thirty inches in size, the lower sill twenty-four inches from the floor, and the other a small outlook, about twelve inches square, up near the ceiling, and looking over the whole cañon beneath. In the upper story, a window corresponded in size, shape, and position to the larger one below, both commanding an extended view down the cañon. The upper lintel of this window was of small, straight sticks of cedar, of about the size of one's finger, laid close together, the small stones of the masonry resting upon them. Directly opposite this window was a similar one, as shown in the figure, but opening into a large reservoir, or cistern, the upper walls of which came nearly to the top of the window. It was semicircular, inclosing the angle formed by the wall against the rock, with an approximate capacity of about two and a half hogsheads. From the window and extending down to the bottom of the reservoir was a series of cedar pegs, about a foot apart, enabling the occupants to easily reach the bottom.

"The entire construction of this little human eyrie displayed wonderful perseverance, ingenuity, and some taste. Perpendiculars were well regarded, and the angles carefully squared. The stones of the outer rooms or front were all squared and smoothly faced, but were not laid in regular courses, as they are not uniform in size, ranging from fifteen inches in length and eight in thickness down to very small ones. About the corners and the



ANCIENT RUINS IN COLORADO.

windows, considerable care and judgment were evident in the overlapping of the joints, so that all was held firmly together. The only sign of weakness was in the bulging outward of the front wall, produced by the giving way or removal of the floor beams. The back portions were built of rough stone, firmly cemented together. The mortar was compact and hard, of a grayish-white, resembling lime mortar, but cracking all over, like some of the adobe mortars. All the interstices between the larger stones were carefully chinked in with small chips of the same material. The partitions were of the same character as the smooth wall outside, both presenting somewhat the appearance of having been rubbed down smooth after they were laid. The apertures from one room to another were small, corresponding in size and position to those outside. Most peculiar, however, was the dressing of the walls of the upper and lower front rooms. Both were plastered with a thin layer of some firm cement, of about an eighth of an inch in thickness, and colored a deep maroon-red, with a dingy white band eight inches in breadth running around the floor, sides, and ceiling. In some places it had peeled away, exposing a smoothly dressed surface of rock. No signs of ornamentation, other than the band alluded to, were visible."

Of some of the other ruins observed in this cañon and photographed, Fig. 1 represents the ground-plan of a round tower, consisting of two circular walls, with the intervening space divided into separate apartments. A tower somewhat larger than usual, adjoining a rectangular structure, is represented by Figs. 2 and 3. The tower was twelve feet in diameter, and at the present time about twenty in height, the wall being some sixteen inches in thickness. Fig. 4 represents a portion of a doorway and one corner of a carefully built house, while Fig. 5 depicts a cliff-house, one hundred feet above the level of the bottom of the cañon, Fig. 6 being a copy of some inscriptions upon the walls of the cañon near by. Another cliff-house, eight hundred feet above the cañon, is represented by Fig. 7, while Fig. 8 indicates the tenacity of the cement, the isolated portion still remaining firmly attached to its foundation. A general view of the cañon of the Rio Mancos near its outlet from the Mesa Verde is given at Fig. 13. The tablelands upon either hand vary from five hundred to one thousand feet in height, and it is in the darkly shaded lines in the upper half of the high bluff on the right that the little houses are found, as shown in Figs. 5, 7, and 12.

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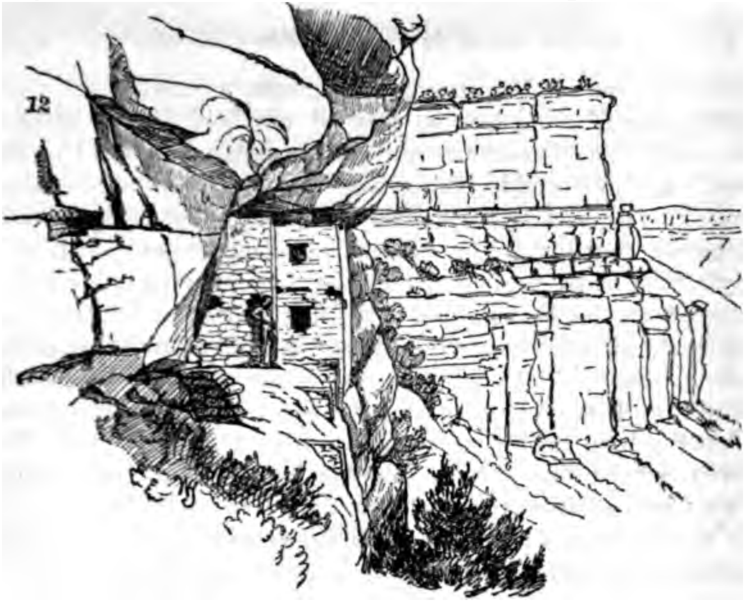

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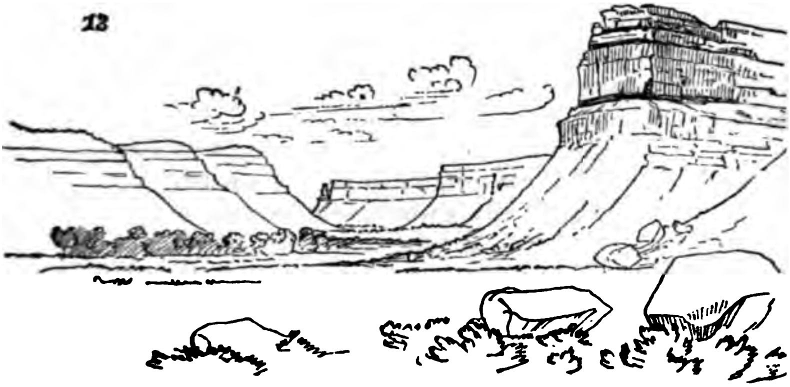

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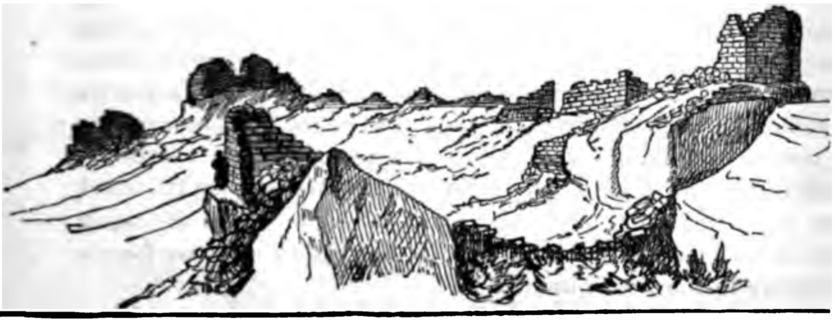

ANCIENT RUINS IN COLORADO.

Passing into Utah, Mr. Jackson came upon the ruins of an Indian village (Fig. 14) situated in the bluffs of the valley of the Hovenweep, of which Fig. 11, Plate II., is a ground plan; the area extended a hundred yards.

In the valley of the McElmo, Utah, was found a square tower (Fig. 9) on the summit of an elevated rock. Fig. 10 represents an isolated rock in the same valley, covered with ruined houses and walls. A Moquis tradition states, according to Mr. Ernest Ingersoll, who accompanied Mr. Jackson's party, that at this spot, in ages past, their ancestors made their last stand against the northern tribes before retreating to their present villages.

Over New Mexico and Arizona are scattered similar ruins which have been described since the sixteenth century, when Vaca saw them occupied. The present Moquis Indians inhabit such structures, and it seems probable that their ancestors, an agricultural people, were driven up the cañons by the incursions of hostile tribes from the north.

RECENT LITERATURE.

Sachs's Text-Book of Botany.[1] — The present translation is based on the third edition of Sachs's Lehrbuch, a work which has been extraordinarily successful in Germany, a fourth edition having made its appearance during the progress of the English translation. It has also been translated into French by Van Tieghem. The difficult task of rendering technical German words and phrases into clear and forcible English has been very well performed by the translators, and it seems to us that they have shown good taste in making but few annotations, and those explanatory rather than controversial. The text and illustrations are excellent, quite as good as those of the German edition, which is certainly saying a great deal.

The mere fact that the present translation has already been favorably received in England and this country shows that it supplies a want which the ordinary English text-books, excellent as they are in some respects, do not satisfy. This want is a book which shall give something more than a description of the organs of flowering plants, and a detailed account of the orders into which they are divided. It cannot be denied that in this country the tendency has been to consider the chief, if not the only aim of botany to be the classification of phanerogams and the description of new species. The excellent translation of Sachs will, it is to be hoped, do much towards correcting this misconception of the true spirit of botany. In the text-book before us only 160 pages are devoted to phanerogams, while the part relating to cryptogams fills 213 pages, and that to physiology a still greater number of pages; so that the reader cannot fail to draw the conclusion that what many botanical students in this country have been in the habit of regarding as the most important thing, is only one branch of the science, and by no means more important than others. Even in that part of the text-book relating to phanerogams there are many ways of looking at familiar subjects which will be new to American botanists, as, for example, the theory of the carpel, and we cannot fail to see that, after all, some things which we have come to regard as facts are nothing but plausible theories, and that other people may have different but equally good theories.

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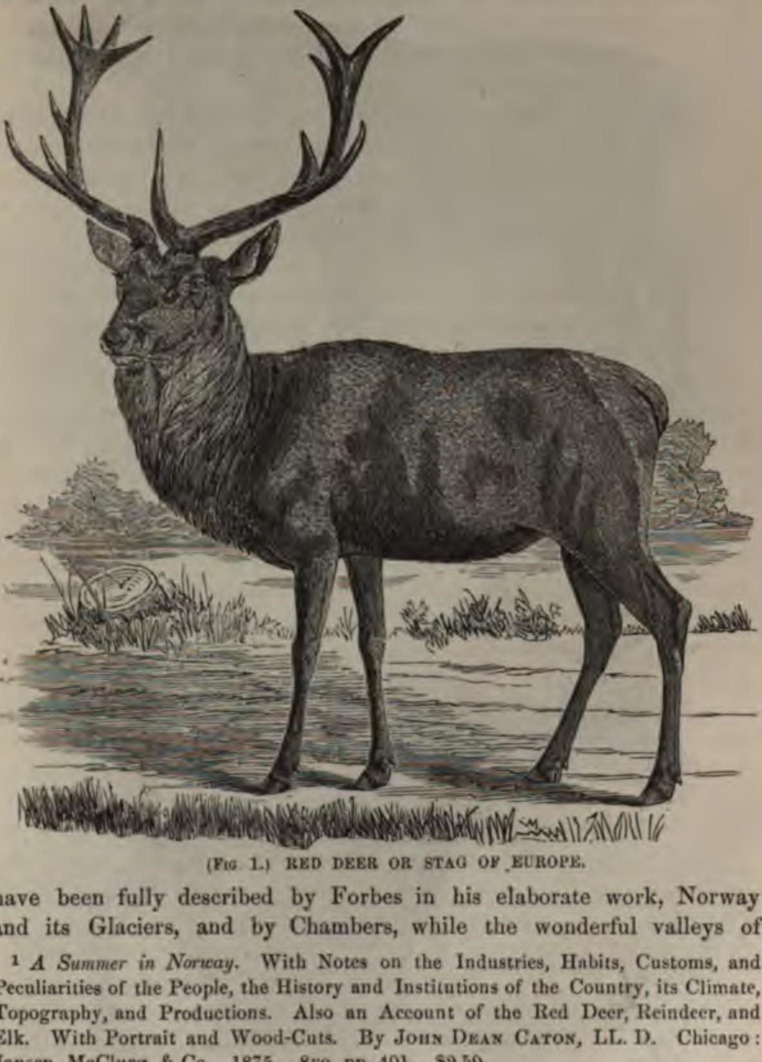
[1] *Text-Book of Botany, Morphological and Physiological.* By Julius Sachs. Translated and annotated by Alfred W. Bennett and W. T. Thiselton Dyer. Oxford: At the Clarendon Press. London: Macmillan & Co. 1875. $12.50.

In the fourth edition of the Lehrbuch is a classification of Thallophytes which is given as an appendix to the translation. Sachs rejects the old division into algæ, fungi, and lichens, and, instead, gives a series of parallel groups, those, on one hand, containing chlorophyll and those, on the other, free from chlorophyll. The existence of parallel groups in algæ and fungi has long been known, but we believe this is the first general text-book in which the division into algæ and fungi has been abandoned. Although in a general way correct, the details of Sachs's classification cannot be accepted. Although Sachs is preëminently a physiologist, it seems to us that he has been quite as successful in his presentation of the researches of others in anatomy and cryptogamy, as of his own researches in physiology. We are not made very much wiser by being told that many motions arise from the tension of tissues, and it seems as though the term *reiz*, which may mean either irritation or some inherent attractive force, were only a learned way of concealing ignorance. Throughout the book we are impressed with the fact that advance in botany during later times has been dependent on the use of the compound microscope. Hereafter it will be as impossible for a botanist to keep up with the times without doing microscopic work as for an astronomer to succeed without a telescope.

It is to be regretted that the price of the translation is so high, but the number and quality of the illustrations probably render it necessary. It would be at least a consolation to American purchasers to know exactly what the price is, or ought to be, in this country. We imported the book directly by mail and were obliged to pay $8.60; others have been charged as high as $12. and one, more fortunate, procured a copy at a book store for $8. It has been suggested that the work be divided into parts to be sold separately, and, although students should not read one part to the exclusion of others, many would be able to purchase the separate parts at different times who could not afford to buy the whole at once. An abstract of the translation corresponding to Prantl's abridgment of the German would hardly be advisable, but a translation of Thomé's Lehrbuch der Botanik, would be preferable.

CATON'S SUMMER IN NORWAY.[1] — From a careful reading of this attractive and unpretending book, and from similar experiences in the southern and middle portions of Norway, we feel entitled to say that Judge Caton has given American readers a thoroughly reliable account of Norway, particularly the extreme north. English books about Norway are not so scarce as the author states, but the present volume gives the most complete and accessible general account of this interesting country we have seen. The author lays no claim to a knowledge of geology; the raised beaches and glaciers, on which he does not dwell, have been fully described by Forbes in his elaborate work, Norway and its Glaciers, and by Chambers, while the wonderful valleys of



(FIG 1.) RED DEER OR STAG OF EUROPE.

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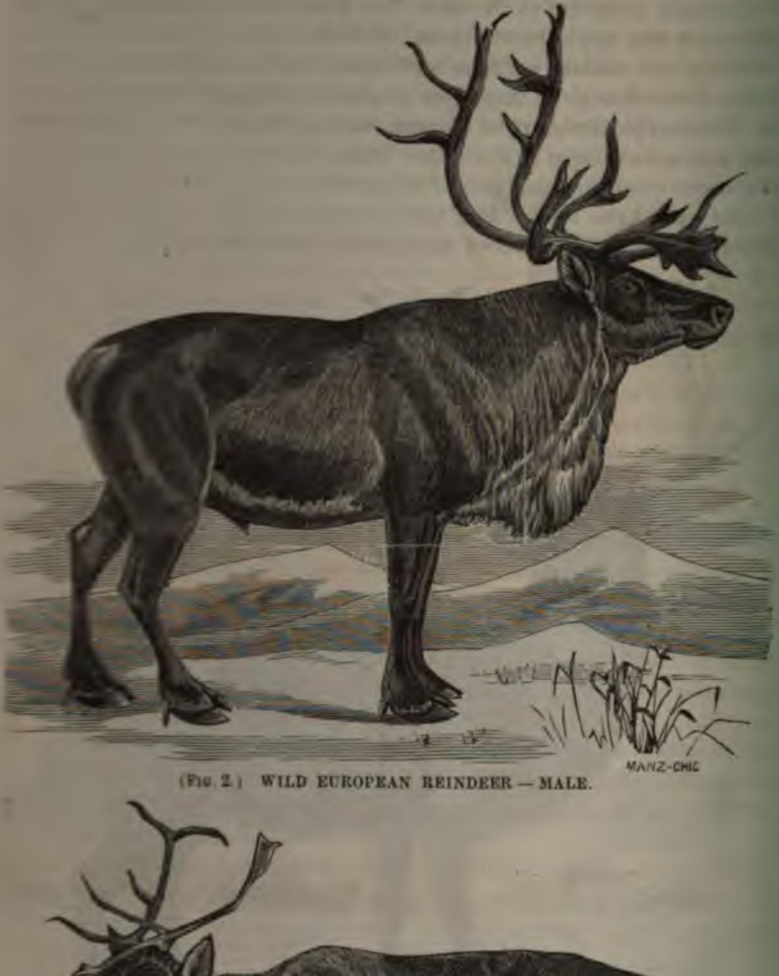
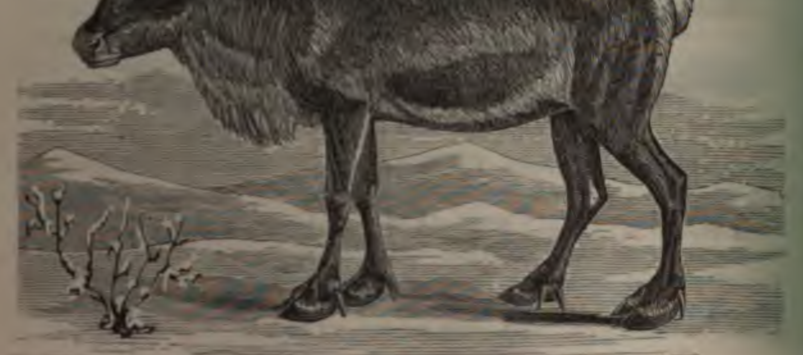
[1] *A Summer in Norway.* With Notes on the Industries, Habits, Customs, and Peculiarities of the People, the History and Institutions of the Country, its Climate, Topography, and Productions. Also an Account of the Red Deer, Reindeer, and Elk. With Portrait and Wood-Cuts. By JOHN DEAN CATON, LL. D. Chicago: Jansen, McClurg, & Co. 1875. 8vo, pp. 401. $2.50.



(FIG. 2.) WILD EUROPEAN REINDEER — MALE.



(FIG. 3.) WILD EUROPEAN REINDEER — FEMALE.

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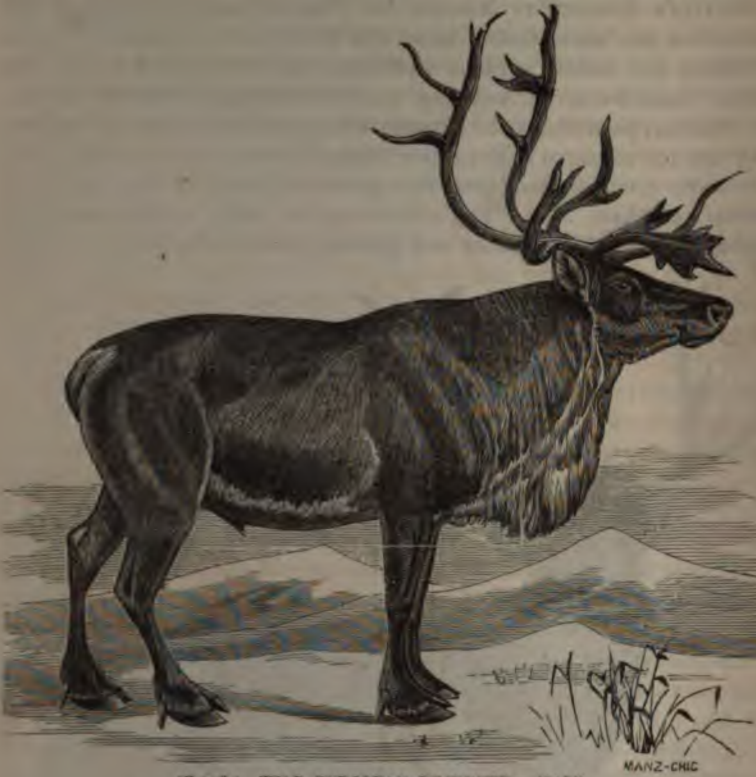
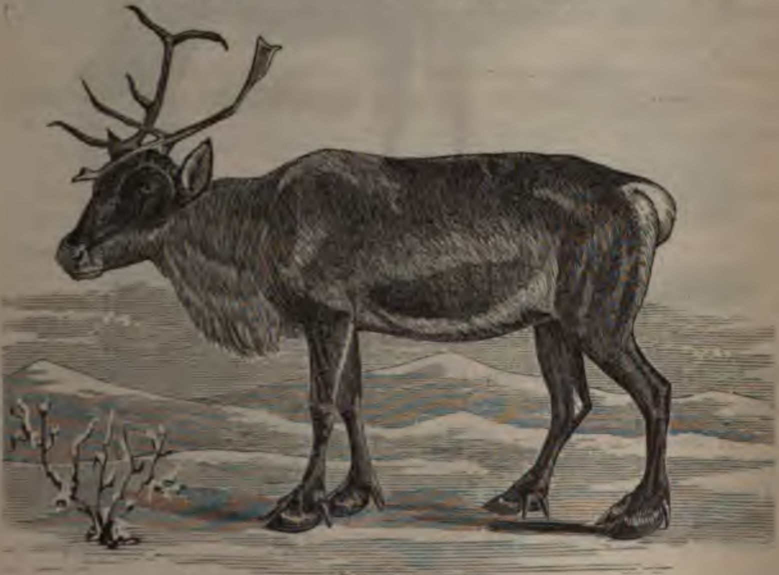


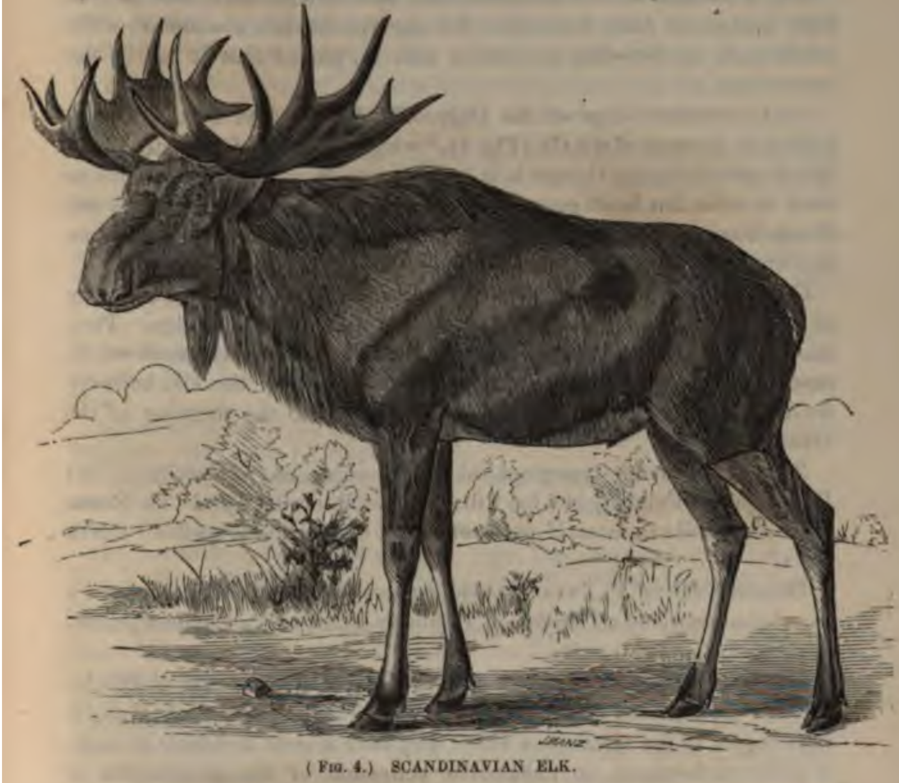
(FIG. 2.) WILD EUROPEAN REINDEER — MALE.



(FIG. 3.) WILD EUROPEAN REINDEER — FEMALE.

Norway, more like the cañons of the West than any mountain gorges we have seen elsewhere, are not mentioned.

But of the reindeer and Scandinavian elk our author speaks with the interest and decision of an expert, and his opinion on the specific relations of these animals with our caribou and moose should receive due consideration.



(FIG. 4.) SCANDINAVIAN ELK.

The red deer (Fig. 1), now confined in Norway to the two islands of Hatterroen and Smöen, and which in Bohemia has successfully interbred with the American Wapati deer, the author suggests is conspecific with the Wapati or American elk (*Cervus Canadensis*). So also the reindeer (Fig. 2, male, Fig. 3, female) is, we believe, correctly regarded as the same species as our caribou. Judge Caton, in his visit to the Lapps, went among a herd of these timid animals, and had a good opportunity of studying them. He remarks that in size "this deer is less than our woodland caribou, with which it is identical in species, but in Eastern Asia the domesticated reindeer is a much larger and finer animal than in Lapland, and closely resembles in form and development our woodland caribou. There they are used for the saddle by the Tunguses, and highly prized for that purpose, as we are informed by Erman." Again, on page 238, he says, "During that examination, with the animal so close before me, and made still more critical by handling it, I became entirely convinced of the specific identity of the reindeer of Lapland and the woodland caribou of America, and in this opinion I was only confirmed by a subsequent examination of the wild reindeer of Norway."

The Scandinavian elk was also at one time domesticated, and successfully broken to draw loads, but the experiment was abandoned, while trials made in America, our author tells us, proved that it can be domesticated.

On the southern edge of the Dovre Fjeld he passed by the present habitat in Norway of the elk (Fig. 4), "which is specifically identical with the American moose, though it is a little less in size and not quite so dark in color, but in all essential particulars they are precisely alike, and if one from either side of the Atlantic were transferred to the other, no one would suspect that he was an emigrant."

Of the quality of the illustrations, our readers, through the liberality of the author and his publishers, have an opportunity to judge. They were drawn by an excellent German artist, from animals preserved in captivity, and while standing quietly. In the case of the elk, however we doubt whether the engraver has done justice to the drawing of the artist.

Some unfortunate typographical errors occur, as "Dover-fjeld" for Dovre-fjeld, "Felle Fjeld" for Fille Fjeld, "Romsdel Fjord" for Romsdal Fjord, while in most, if not every case, Christiania is spelled "Christiana."

DICHOGAMY IN PLANTS.[1] — Our readers will recall with pleasure a translation of some of Professor Delpino's notes on this subject printed in this journal, July, 1871.

The present work is far more comprehensive than its modest title indicates. It classifies the insect-visited flowers upon a new basis, namely, with regard to the attractions which they offer insects, and birds as well; it presents, however, an exhaustive statement of the peculiarities of structure which render close-fertilization unlikely. As a mere hint of the method, we will allude to the group of odoriferous blossoms. These flowers are divided into two classes, *sympathic* and *idiopathic*. The former is subdivided into those flowers which are (1) sweet-smelling, (2) aromatic, (3) fruity in odor, like *Calycanthus*. The second class, comprises (4) those with heavy odor (e. g., *Papaver*), and (5) those which are nauseous, as some of the stapelias. But it must be further stated that these five classes are broken up again into forty-five smells, and each smell has a name! The author has, here and there, made a little blunder of an amusing, but not serious character. For instance, our old friend of the bogs, skunk cabbage, figures as *Pothos fœtida*, under the head *odore alliaceo*, and again with the name *Simplocarpus* (sic) *fœtidus* in the monotypic class *odore mefitico;* which is not so bad, after all. The volume is as attractive to entomologists as to botanists; both will find it full of suggestions in regard to examinations of flowers and their visitants; both will complain that a work so full of details should have no index. The table of contents is analytical and full, but does not replace the index which we have the right to expect.

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[1] *Ulteriori Osservazioni sulla Dicogamia nel Regno vegetale*, per FEDERICO DELPINO: parte seconda, pascicolo ii. Milano, 1875.

Later Observations and Considerations respecting Dichogamy in the Vegetable Kingdom. By F. DELPINO. (This volume of 350 pages is an extract from the Proceedings of the Italian Society of Natural Sciences in Milan, vols. xvi., xvii.)

Recent Books and Pamphlets. — The Structure and Development of the Sting and Ovipositor of Certain Hymenoptera and the Green Grasshopper. By Dr. H. Dewitz. 8vo, pp. 26. (From Siebold and Kölliker's Zeitschrift.)

List of the Fishes, Tunicata, Polyzoa, Crustacea, Annulata, Entozoa, Echinodermata, Anthozoa, Hydrozoa, and Sponges known from Greenland. Compiled for the use of the British North-Polar Expedition. By Dr. Chr. F. Lütken. 1875. 8vo, pp. 115 to 197. London.

The Vertebrata of the Cretaceous Formations of the West. By E. D. Cope. United States Geological Survey of the Territories. Washington, D. C., 1875. 4to, pp. 303. With 57 lithographic plates. (For sale by the Naturalist's Agency, Salem, Mass.)

Recherches sur les Phénomènes de la Digestion chez les Insectes. By F. Plateau. Bruxelles. 1874. 4to, pp. 124, 3 plates.

Check List of the Noctuidæ of America North of Mexico. By A. R. Grote. I. Bombyciæ and Noctuelitæ. Buffalo, N. Y. 1875. 8vo, pp. 28, with a plate. (For sale by the Naturalist's Agency, Salem, Mass.)

The American Journal of Microscopy. New York Industrial Publication Co. Vol. I. No. 1. December, 1875. 8vo, pp. 12. Fifty cents a year, single number six cents.

The Illustrated Annual Register of Rural Affairs for 1876. Albany, New York: Luther Tucker and Son. No. 22. 12mo, pp. 134.

Synopsis of the Odonata of America. By Dr. H. A. Hagen. (From the Proceedings of the Boston Soc. Nat. Hist. xviii, 1875.) Boston, 1875. 8vo, pp. 76.

Bulletin of the United States National Museum. No. 1. Check List of North American Batrachia and Reptilia. By Edward D. Cope. (Department of the Interior, U. S. National Museum.) Washington, D. C. 1875. 8vo, pp. 104.

Die Gastrula und die Eifurchung der Thiere. By Ernst Haeckel. (From the Jenaische Zeitschrift, 1875.) With 7 plates. 8vo, pp. 106.

GENERAL NOTES.

BOTANY.[1]

Dichogamy in Epilobium angustifolium. — That the anthers shed their pollen before the stigmas of that flower are in condition to receive it, is one of the observations of Sprengel, at the very beginning of our knowledge of this subject. But he seems not to have called attention to the additional security against close-fertilizing, caused by the recurving of the style during the early anthesis, while the pollen is shed-ding, and its erection afterwards so as to bring the now expanded stigmas into the line of the axis of the blossom. Nor does Lubbock allude to anything of the kind. This I shall elsewhere illustrate. The present object is to call attention to a point which I had not observed, but which is mentioned in a letter from a former pupil, Mr. W. M. Courtis ; namely, that only seven of the stamens shed their pollen before the stigmas expand, the eighth anther opening afterwards ; or in some flowers two anthers are thus late ; "as if it might be nature's plan to insure cross-fertilization if possible, but if not, self-fertilization would be possible." This should be looked after next summer. — A. GRAY.

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[1] Conducted by Prof. G. L. Goodale.

DIMORPHISM IN CLAYTONIA. — The number of hermaphrodite flowers in which either dichogamy or dimorphism is known to occur, already large, increases with attentive observation. Mr. E. L. Hankenson, of Newark, New York, finds two forms of *Claytonia Virginica*, and sends copious specimens ; one form has an elongated style and short filaments ; the other long filaments which equal or overtop the style, the latter, however, not absolutely shorter than in the counterpart form. It would be interesting to know if this holds true generally. — A. GRAY.

CHEILANTHES ALABAMENSIS. — As ferns are now much sought, it is worth recording that Mr. Walter Faxon last summer discovered this southern species within the limits of Gray's Manual, on Indian Creek at the boundary between Lee County, Virginia, and Claiborne County, Tennessee. — A. GRAY.

THE HOLLYHOCK PUCCINIA. — A note in the October NATURALIST, by Mr. Meehan, in which he states that *Puccinia malvæsarum* has probably existed in this country for many years, leads me to say that ever since notices in foreign journals, regarding the sudden and widespread appearance of this fungus in Europe, have appeared, I have taken more notice than usual of all hollyhocks that I have met with (and the plants are abundant in this country, not only in cultivation but as garden weeds and scapes to roadsides), but have failed to find the *Puccinia*. On several occasions I have found at roadsides hollyhock plants whose leaves were densely covered with brownish spots, and having the same appearance as leaves infested with the *Puccinia* (of which I have many specimens from England and Germany) ; on examination, however, no fungus was found. but it appeared to me that the spots were of insect origin. If not the work of insects it may be possible that they were due to a species of *Phyllorticta* (*P. destruens* Derm. ?) whose perithecia would have appeared later in the season. — W. R. GERARD.

VITALITY OF SEEDS. — H. Hoffmann reviews in the *Botanische Zeitung*, October 15 and 22, 1875, the vexed question of vitality of seeds. After giving references to the literature of the subject, which, by the way, he does not treat at all critically, the author describes experiments with *löss*, a diluvial earth found in the valley of the Rhine. When the railroad station Monsheim (at Worms) was built, the earth was dug away to a depth of twelve feet. Some of the *löss* was taken with necessary precautions, and securely sealed until the following spring (1865). In May, twenty-four flower pots were half-filled with manure which had been heated in order to destroy any seeds present, and on this substratum some of the *löss* was placed, leaving an air space above, of two inches, and each pot was covered by a glass disk which had a bit of wood under one edge to allow access of air. The surface of the *löss* soon had plenty of ferns and mosses, just like those which are so abundant in all greenhouses. A few phænogamic plants came up; four which could not be determined accurately were supposed to be *Vaccinium myrtillus*, a second, a *Chrysanthemum Leucanthemum;* afterwards a third came up, a *Galium*, and finally an *Equisetum.* A second series of experiments, conducted with greater care to exclude all waifs, gave wholly negative results. Some molds, a coat of moss, and a single grass, *Festuca pratensis*, were the only plants within the bell-jars.

THE PRIMORDIAL UTRICLE. — Professor Pfeffer has lately studied the so-called primordial utricle, with the following results, which are given in the *Botanische Zeitung*, October 1st, from *Kölnische Zeitung*, 1875, 248. Protoplasm placed in contact with aqueous solutions becomes clothed on all sides with a delicate membrane caused by precipitation. This is the so-called primordial utricle. In protoplasm, certain albuminoids are dissolved, which separate out in water because their solvent is withdrawn. But this is limited to the surface of contact, because the membrane formed by precipitation does not allow the solvent to pass through. What this solvent is, has not been ascertained positively, but it is believed to be something beside the inorganic salts which, in egg-albumin, hold a protein substance in solution.

ORIGIN OF HIGH HYDROSTATIC PRESSURE IN VEGETABLE CELLS. — In the *Botanische Zeitung*, November 5th, there is an abstract of a communication made by Professor Pfeffer to the botanical section of the Association of German Naturalists and Physicians, at Graz, 1875, on the subject of the origin of high hydrostatic pressure in vegetable cells. This pressure, amounting sometimes to several atmospheres, even where there is only slight concentration of the fluid contents of the cells, led him, on theoretical grounds, to refer it to the molecular condition of the primordial utricle. This conclusion was confirmed by experiment. With contraction of the molecular interspaces, resistance to filtration increases, and likewise the pressure which is brought about endosmotically. Thus in the case of the precipitated membrane of ferrocyanide of copper (see Sachs's Text-Book, p. 597) a pressure of two atmospheres can be obtained, provided the film finds a suitable support, in a two per cent. solution of cane sugar. In the brief account given, there are no details as to the method of determining the amount of pressure. The resistance of the membrane to filtration is a complex force dependent on several variables, but with changes in this resistance, hydrostatic pressure is changed; for instance, by heating, since thus the molecular interspaces are increased. This theory was then ingeniously applied to the explanation of periodic movements in plants.

BOTANICAL PAPERS IN RECENT PERIODICALS.—It is intended to give under this head the titles of the principal papers relating to botany and vegetable physiology, contained in the scientific journals and proceedings of societies. The enumeration will not always be exhaustive, nor will short notes or memoranda be mentioned unless of particular interest. A few of the following titles are at second-hand from Sklarek's *Repertorium der Naturwissenschaften*, October, 1875.

American Journal of Science and Arts, November, 1875. Æstivation and its terminology, by Prof. Asa Gray (gives the history, and discusses the question, of the proper term to be applied to the mode variously called *obvolute*, *contorted*, or *convolute*).

Bulletin of the Torrey Botanical Club, New York, October and November, 1875. Lichens of Kerguelen's Land, by Professor Edward Tuckerman. (Among the species collected by Dr. Kidder in the U. S. Transit Expedition is a new genus, *Urceolina.*) Notes upon *Anychia dichotoma*, by John H. Redfield (suggests the reëstablishment of two species). Dimorphism or trimorphism in *Pontederia cordata*, by W. H. Leggett.

The Journal of Botany, British and Foreign, November, 1875. Descriptions of new plants from the Nicobar Islands, etc., by S. Kurz (giving also a short account of the principal features of the vegetation of this group in the Indian Ocean). New lichens from Kerguelen's Land, by the Rev. J. M. Crombie. Professor Tuckerman's paper in the October number of the Bulletin of the Torrey Club has a month's priority.

Quarterly Journal of Microscopical Science, October, 1875, has two photographs of microscopic preparations of the resting spores of the potato fungus. Mr. W. G. Smith observes that the organisms now photographed are identical with the bodies found thirty years ago by Dr. Rayer, of Paris, and afterwards placed in the hands of Rev. Mr. Berkeley. These specimens are still in existence and have been photographed to the same scale as the recently found bodies. In the same journal Professor McNab gives a condensed translation of Dr. Oscar Brefeld's memoir on the life-history of *Penicillium*, a genus of low fungi to which the common pale blue mold belongs.

Journal of the Linnean Society, October 11th. Notes on the Gamopetalous orders belonging to the Campanulaceous and Oleaceous groups, by George Bentham (dealing with the development of the former group and the geographical distribution of both). Notes on the occurrence of "fairy-rings," by J. H. Gilbert. "The highly nitrogenous fungi flourished strikingly, and appeared in 'fairy-rings' on two plots only," in Mr. Gilbert's experiments. "On neither of these was nitrogen or potass applied as manure." On the characteristic coloring-matters of the red groups of *Algæ*, by H. C. Sorby. Six different characteristic coloring-matters, soluble in water, have been detected and are here described. The six are referred to two typical coloring-matters, *Phycocyan* and *Phycoerythrin.*

The Gardeners' Chronicle, November 20, 1875. Rue, a popular account of its historical and legendary associations. Autumn tints of trees, by J. McNab. *Garcinia mangostana*, by Mr. Prestoe, of Trinidad (an interesting description, with plates, of the fruit of the mangosteen).

Comptes rendus des Séances de l'Académie des Sciences, September 20, 1875. On the rôle of the protective sheath of the vascular bundles in herbaceous dicotyledons, by J. Vesque. On the development and structure of glands within the leaf, by J. Chatin. September 27th. Abnormal variation of hybrid plants, by Ch. Naudin.

Annales des Sciences Naturelles, Botanique, 1875–1–1. New researches respecting the *Mucorineæ*, by Ph. Van Tieghem. To be hereafter noticed.

Jahrbucher für Wissenchaftl. Botanik, Bd. X., heft 2. On the anatomy of leaves, by Reinke (with special reference to certain glands occurring on them). On the fertilization of *Basidiomycetes*, by Max Reess. Germination of the spores of *Cyathus* (a gastromycetous fungus), by R. Hesse. On the development of certain leaves, by A. B. Frank (treating chiefly of the theory of interposition).

Flora, 1875, No. 22. On growth, and the formation of chlorophyll, by C. Kraus. (The formation of chlorophyll does not retard growth.) No. 23. Abnormal fir-cones, by Döbner. On the action of vegetable acids on chlorophyll within the plant, by C. Kraus. (No effect produced unless the protoplasma and the contained chlorophyll are enfeebled.) No. 26, On abnormal cones, by A. Braun.

Botanische Zeitung, October 1st to November 5th, inclusive. Fertilization of species of *Agaricus*, by Dr. E. Eidam. In reports of societies: *Göttingen*, H. Conwentz shows that the microscopic anatomy of the vascular bundles may be sometimes used as a diagnostic character in ferns. *Bonn:* On the formation of the primordial utricle, by Professor Pfeffer (elsewhere noticed). *Leipsic:* An examination of certain lichens with respect to the Schwendener theory, by G. Winter (favorable to the theory). New *Peronosporeæ*, by Schenk. On certain fungi, by G. Winter. On intercellular thickening in the cellular tissue of ferns, by Luerssen. On flesh-eating plants, by Reess and Will. (Investigations made before the appearance of Mr. Darwin's treatise, and generally confirming his results, by more technical methods of research.) On the origin of high hydrostatic pressure in vegetable cells, by Dr. Pfeffer (elsewhere noticed). On the morphology of vascular cryptogams, by Dr. Frank (comparing them with the lower grades). On the lower limits of sexuality in plants, by Dodel-Port. On fertilization, by Strasburger. On the plants of Ætna, by Professor Strobl. *Brandenburg:*

On the arrangement of the leaflets in ferns and cycads, by A. Braun. (The leaflets in the former have the posterior edge of the one leaf covering the anterior edge of the one behind it; the leaflets in cycads are the reverse of this. There are said to be a few exceptions in ferns.) *Halle:* On the anatomical structure of the roots of certain *Convolvulaceæ*, by Schmitz. (This paper is of pharmaceutical interest, being devoted to the detection of adulterations in drugs of the order, such as jalap.) A contribution to the subject of the vitality of seeds, by H. Hoffmann (elsewhere noticed). Some other notices are unavoidably deferred.

ZOÖLOGY.

THE EXTINCTION OF THE GREAT AUK AT THE FUNK ISLANDS. — Mr. Michael Carroll, of Bonavista, Newfoundland, has recently given me the following very interesting facts respecting the extermination of the great auk (*Alca impennis*) at the Funk Islands. In early life he was often a visitor to these islands, and a witness of what he here describes. He says these birds were formerly very numerous on the Funk Islands, and forty-five to fifty years ago were hunted for their feathers, soon after which time they were wholly exterminated. As the auks could not fly, the fishermen would surround them in small boats and drive them ashore into pounds previously constructed of stones. The birds were then easily killed, and their feathers removed by immersing the birds in scalding water, which was ready at hand in large kettles set for this purpose. The bodies were used as fuel for boiling the water. This wholesale slaughter, as may well be supposed, soon exterminated these helpless birds, none having been seen there, according to Mr. Carroll, for more than thirty years, and he expresses great doubt in respect to the existence of the species now anywhere about the islands of Newfoundland or Labrador. — J. A. ALLEN.

BEWICK'S WREN, *Thyothorus Bewicki*, is something of a rarity, I believe, in the Atlantic States, where its movements, and especially its breeding resorts, are not very well made out. It may, therefore, be worth while to here record the fact that it breeds in considerable numbers in these same mountains. I saw two or three individuals during my ride up and down the mountains; and, though I found no nests, the actions of the birds satisfied me that they were at home for the summer. — ELLIOTT COUES.

RANGE OF THE BAY IBIS. — A letter from Captain C. Bendire, U. S. A., to E. Dickinson, Esq., dated Camp Harney, Oregon, says, "I have lately discovered that *Ibis Ordi* breeds near here. An officer has sent me portions of a skin, sufficient for identification, and writes me that he saw the young birds, besides some forty old ones." — ELLIOTT COUES.

EARLY NESTING OF THE ANNA HUMMING-BIRD. — In the Ornithology of California, i. 359, I stated that the young of *Calypte Anna* are sometimes hatched as early as March 15th, but never having met with eggs, I was not aware until this year that such is their usual habit near San Francisco. The extensive cultivation of Australian trees may, perhaps, have helped to make this early nesting more general, as in this climate such trees, as well as other subtropical garden plants, are covered with flowers, supplying winter food for these humming-birds more plentifully than the native plants formerly did. But whether a "new departure" or not, my boy (eight years old) found three nests of this species within a stone's throw of the house, between February 15th and 20th, all on low branches of the Eucalyptus (or Australian blue gum), between ten and twenty feet above the ground. These trees are covered most of the winter with large flowers, in which there is much honey, and the acacias of several species, also blooming at this season (like most *antipodal* trees), have been very attractive to the hummers, as well as to minute insects on which they feed. They have likewise utilized the long, silky stamens of some acacias in building their nests, though still using chiefly the down from various native herbs, the platanus, willow, etc., besides going a long distance to find lichens to adorn the nests outside, although there are none of these parasites on their favorite gum-trees.

I have since seen another nest built on a densely-leaved twig of a Monterey cypress, adding to the variety of locations before described, and this was a few yards only from a noisy hotel on the main road. To add to the completeness of their history I watched one nest to note time of incubation, and found it sixteen or eighteen days *at least* [while the Eastern species needs but thirteen. — *Brewer*]. One brood was hatched before March 1st, another on the 5th. This is while only two truly summer visitors have arrived, the *Hirundo bicolor* (January 30th) and *Selasphorus rufus*, the latter (Nootka hummer) first seen February 16th, but does not build until April or May.

In the nest observed, one young died, but the other was fledged and left it on March 30th, quite able to make short excursions for food in fifteen days. I had seen fledged young ones about the Eucalyptus trees several days earlier, so that they must hatch in many nests as early as March 1st. Three cold rains occurred during the development of the one I watched. During all the time of development both of eggs and young there have been white frosts at night and fresh, piercing cold winds during the day. As with the Nootka Hummers the females perform the task of hatching and feeding the young entirely by themselves, the males disappearing from the lowlands and gardens after the eggs are laid, and retiring among the richer flowers of the mountain cañons.

My correction of Nuttall's account of the nest of this species is confirmed by these specimens, which are much larger than that he describes, being 1.75 inch, instead of 1.25 wide, etc. But as he caught the female on the nest, with the eggs in it, and describes the bird (as *Trochilus icte-*

rocephalus), at the same time stating that it is the one mentioned by Audubon as the female of the Anna, he must have made an error in measuring it, especially as he gives the height correctly. His specimen, by the way, is mentioned by Baird and others as a "*male* with forehead covered with yellow pollen." This mistake may arise from its having a red metallic patch on the throat, not mentioned in their descriptions of the female, but I can state from seeing hundreds of females in spring, that they *have* this patch as well as young males in fall. The female Nootka hummer has it also, as late authors state, though Nuttall was doubtful about it.

I may add that the only other small bird yet building here is the bluebird (*Sialia Mexicana*), and this only inside of buildings or hollow trees. — J. G. COOPER, Haywood, Alameda County, Cal.

INTELLIGENCE IN THE HAWK MOTH. — While watching the sudden unfolding of the flowers of the *Œnothera Lamarkiana*, we observed that the hawk moths never visited the same flowers twice, even when frightened away by some motion made by us. On returning, they would go only to those flowers that had opened during their absence, or that had not been visited before their flight. — J. M. MILLIGAN.

PERFORATION OF ORANGE SKINS BY MOTHS. — The proboscis of Australian moths of the genus *Ophideres* is said to be so stiff, and even barbed, that it is capable of perforating the most resisting envelopes. The moths thus perforate oranges in order to feed upon their juices. M. Künckel has examined the specimens forwarded to him by M. Thozet, a French botanist, and says, " It is incorrect to call the proboscis rigid, as it curls up in the usual way; but instead of a soft terminal portion, it has a hard one. The two adpressed maxillæ terminate in a sharp triangular point, furnished with two barbs. They then swell out and present on the lower surface three parts of the thread of a screw, while their sides on the upper surface are covered with short spines springing from a depression with sharp, hard sides. These spines are to tear the cells and the pulp of the oranges, as a rasp opens those of beet root, to extract the sugar. The upper portion of the proboscis is covered from below and on the sides with fine serrated striæ disposed in a half helix, which give it the qualities of a file. These striæ are from time to time interrupted by small non-resisting spines, which serve as tactile organs. The orifice of the canal by which the liquids ascend is situated on the lower face, below the first thread of the screw.

" Not content with examining *Ophideres Fullonica*, I studied *O. salaminia*, *O. materna*, and *O. imperator*, which all had auger-like probosces. The structure of these maxillæ affords a generic character of great value; it moreover establishes a closer relation between the lepidopters, the hemipters, and certain dipters which have maxillæ adapted to pierce tissues." — *Monthly Microscopical Journal*, London.

THE EUROPEAN TREE SPARROW IN THE UNITED STATES. — It will interest ornithologists to know that the tree sparrow of Europe (*Pyrgita montana*) has lately been discovered to be a resident of the United States.

The resemblance of this species to the English house sparrow has led me to be on the watch for it since the introduction of the latter, but without success until I found it in St. Louis, Mo., last spring. Here I found the new species abundant, but was unwilling to take any until the breeding season was over. Four skins sent to Mr. G. N. Lawrence, of New York, are pronounced by him to "agree accurately with the plate and description of this species." He also informs me that about five years ago Mr. Eugene Schieffelin noticed fifty or sixty of these birds in the store of a bird importer in New York, where they were unrecognized; and these were probably afterwards sold as or with *P. domestica*. This is undoubtedly the explanation of their occurrence here, and further search will very likely show their presence in other localities.

With a general resemblance to the common house sparrow, *Pyrgita montana* is readily distinguished by its chestnut crown and the similarity of both sexes and the young. In St. Louis it considerably outnumbers *P. domestica*, and, as is the case in Europe, it prefers the outskirts of the city and the country. In other respects these two species closely resemble each other. — DR. JAMES C. MERRILL, U. S. Army.

ANTHROPOLOGY.

ANTIQUITY OF MAN. — Mr. Southall, in his late work on the Recent Origin of Man, founds an argument against the antiquity of man's origin in the fact that what are unquestionably paleolithic implements are occasionally found on the surface of the ground, either alone or associated with neolithic or polished stone implements. There are two reasons why such a commingling of the two forms does not militate against this division of an unquestioned stone age. It should be remembered, in the first place, that paleolithic implements, after being long buried in strata of sand or gravel, may become exposed by floods, landslides, or through ice-action, as when an ice-gorge causes a river to cut for itself a new channel, thereby sweeping away the soil over a considerable belt of country. Subsequently, the river resumes its older channel, and the newer implements in time are dropped and so mingled with the exposed older forms. From what I have seen of the action of the Delaware River along its valley, especially between the cities of Trenton and Bordentown, in New Jersey, I have satisfied myself that such may have occasionally been the case during the occupancy of this neighborhood by the Indians. Secondly, if the Indians were the first and only inhabitants of the Atlantic coast of America, prior to the arrival of the Europeans, it is quite certain that they were a paleolithic people when they reached these shores, and whatever may have been the geological changes subsequently, they maintained their ground, and very gradually learned to utilize the more difficultly wrought minerals in fabricating stone implements, and thereby reached the polished stone period. In this way, the two forms would be necessarily mingled; but it must be remembered that as a rule the two forms are not associated. Where one paleolithic implement is found upon the surface, a hundred are quite deeply imbedded in the soil, and in the underlying gravels.—CHARLES C. ABBOTT, M. D.

INDIAN GRAVES IN NEW JERSEY.—The graves of Indians found here in central New Jersey vary to a considerable degree, and suggest the probability that tribes having different burial customs successively occupied this territory. On the terrace that faces the east side of the Delaware River, below Trenton, where I have gathered thousands of stone implements, the graves are to be detected by the discoloration of the soil and the little series of relics that were deposited in each grave. These graves, now a foot or more deep, were in all probability "surface burials," i. e., the body, encased in skins and covered with bark, was placed on, not in, the ground. In time the grave would become covered with leaves and sand, and so gradually be covered with a thin layer of vegetable mold and earth. The gradual increase in the depth of the soil, which is ever in progress in wooded countries, would result in making the surface burial really an inhumation, and as such we now find it. This shallow grave, with every vestige of the skeleton long since gone, and simply indicated by a few arrow-points, an ax, and possibly a pipe, bears every indication of antiquity, and yet doubtless is simply the grave of an Indian. There is one feature connected with these graves and the scattered relics, as we find them, that deserves attention. The rude implements, never polished, and made of the river rock, which we have maintained were strictly paleolithic implements, are never found in these graves, or in any graves that we have examined. Had these ruder implements been used as a general thing, at the same time that the polished celt and jasper arrowheads were made, then they would likewise have been deposited in the graves; for the contents of an Indian grave are the implements and ornaments the occupant used and wore during his life-time. Like the implements themselves, these graves are proofs of the great antiquity of man's origin along the Atlantic coast of America.—CHARLES C. ABBOTT, M. D.

GEOLOGY AND PALÆONTOLOGY.

COMSTOCK'S GEOLOGY OF WYOMING.—This report is to be found in Captain Jones's Report upon the Reconnaissance of Northwestern Wyoming including Yellowstone National Park, made in the Summer of 1873. The portion by Prof. Theo. B. Comstock relates to the structural geology of the country passed over, and contains new matter regarding the celebrated hot springs and geysers of the Yellowstone Park, with archæological and philological notes relating to the Indian tribes, particularly the Shoshones. The report is accompanied by a large colored geological map. We hope hereafter to print some extracts concerning the geysers and Indian inscriptions.

COPE'S CRETACEOUS VERTEBRATES. — This elaborate and lavishly illustrated quarto volume, issued as one of the final reports of Hayden's Survey, forms a worthy successor to the palæontological monographs of Leidy and Lesquereux, also published by Hayden's United States Geological Survey of the Territories.

SCUDDER'S FOSSIL BUTTERFLIES is another exquisitely printed and illustrated monograph of a high order of merit, on a subject quite novel and as interesting to European students as to home observers. We shall return to these works in subsequent numbers.

HYATT'S FOSSIL AMMONITES, with the works previously cited, witness the activity now shown by American palæontologists. Several papers by Professor Hyatt have been issued during the past year, giving the results in brief of the studies of many years on the supposed genetic relations and classification of different groups of Ammonites. Of much interest in connection with the hypothesis of evolution are the papers entitled Biological Relations of the Jurassic Ammonites, and Genetic Relations of the Angulatidæ. An elaborate monograph by Professor Hyatt of certain groups of Ammonites, particularly the *Arietidæ*, to be illustrated by a number of plates, is to be soon published by the Museum of Comparative Zoölogy.

WINCHELL'S GEOLOGY OF THE BLACK HILLS forms the geological report appended to Captain Ludlow's (U. S. Engineers) Reconnaissance of the Black Hills of Dakota, 1874, but only lately published. The report fills fifty-five quarto pages, embracing also a list of trees and shrubs, and is accompanied by a colored geological map of the route surveyed.

KERR'S GEOLOGY OF NORTH CAROLINA. — Last of all is laid upon our table Prof. W. C. Kerr's Report of the Geological Survey of North Carolina, Vol. I., Raleigh, 1875, containing Physical Geography and Economical Geology, with maps and lithographic plates of fossils, described by Messrs. Conrad and Cope.

THE FOSSIL PLANTS OF AMERICA. — Already the study of the North American fossil plants has supplied, in regard to the distribution of the species at different periods, some important information, which modifies a few of the conclusions derived from European vegetable palæontology. Though the isothermal zones have been evidently of a width proportionate to the age of the geological periods, producing in the Carboniferous times, for example, uniformity of vegetation over the whole northern hemisphere, if not over the whole surface of the earth, it appears that there was already at this period a continental or local facies marked in the groups of vegetation. The North American character is recognized in the coal flora of this continent by Schimper, in his

Vegetable Palæontology, as it has been for a long time exposed by the works and descriptions of American authors, and this facies becomes more and more distinct in the more recent periods. The precedence of vegetable types in the geological flora of this continent is distinctly recognized, and therefore the hypothesis of the derivation of the North American flora from Miocene European types is necessarily set aside. On this last question, former remarks in this paper prove the unity of the present flora, derived by constant succession of related vegetable forms from the Cretaceous, at least. On the question of precedence of vegetable types, it has been remarked that the appearance of land-plants is positively recognized in the Silurian of Michigan, while no land-plants have as yet been described from formations lower than the Middle Devonian of Europe; that also we find already in the Devonian of the United States trunks of conifers recognized as prototypes of the *Araucaria*, which are only found later, in the Subcarboniferous of Europe. Our Carboniferous flora has a number of its forms appearing later in the Permian of Europe. The Triassic flora of Virginia and North Carolina is half Jurassic. A number of Cretaceous genera of the Dakota group are reproduced in the Miocene of Europe, as they are, too, in some of the North American Tertiary vegetable groups, and also in the flora of this epoch. Therefore the vegetation of the European Miocene seems partly referable to the American Cretaceous. And in following the comparison upward, we find, in what is considered the Eocene of the Lignitic of the Rocky Mountains, a larger number of forms identical or closely allied to European Miocene species, while the Miocene group of Carbon represents the youngest type of the Tertiary flora of Europe and Greenland, with species of *Platanus*, *Acer*, etc., scarcely distinguishable from indigenous species of our present flora. — *Lesquereux's Review of the Fossil Flora of North America.* (Bulletin of Hayden's Survey of the Territories, second series, No. 5, November, 1875.)

FOSSIL VERTEBRATES OF NEW MEXICO. — Professor Cope, in a preliminary report to Lieutenant Wheeler, in charge of the United States Geographical Survey west of the one hundredth meridian, enumerates eighty-three species of vertebrate animals as having been discovered by him in the deposits of the Eocene lake that once covered the northern and western parts of New Mexico. Of these, eight are fishes, twenty-four reptiles, and fifty-one mammals. Of the whole number, fifty-four species were introduced for the first time to the notice of scientists. This fauna is nearly related to that of the Eocene of Wyoming in many respects, but differs in the different distribution of many of the genera. Thus, *Palæosyops*, a genus abundant in Wyoming, is not found in New Mexico, while *Bathmodon*, which does not occur in the Bridger beds of Wyoming, is the most abundant type in New Mexico, parts of over one hundred and fifty individuals belonging to seven species having been found by Professor Cope. Small tapiroid animals of the genus *Ovohip-*

pus are abundant, and at least eleven species of lemurine monkeys were found. The carnivorous animals discovered numbered eleven species, some of which were as large as the jaguar, or larger. They are all quite distinct from living genera excepting one genus, which is related to the Asiatic civets. Some very small insectivora were also found, one of which is not larger than a small shrew. The waters of the lake abounded in turtles, crocodiles, and gar-fishes.

GEOGRAPHY AND EXPLORATION.

Wheeler's Reconnaissance of Southern Nevada. — This expedition spent six months in exploring southern and southwestern Nevada in 1869; the results, however, were not published until 1875. The report contains much new information regarding the Indian tribes and southern Mormon settlements. The chief geographical point of interest is the erasing of Preuss Lake from the maps, which was in 1872 found by Lieutenant Wheeler to be the southern shore of Sevier Lake.

African Travel. — An expedition to Central Africa up the Congo River, under Dr. Güssfeldt, failed to accomplish its object owing to the fact that the natives are poor carriers, and were in dread of meeting cannibals in the interior, as well as from the ill-health of Dr. Gussfeldt. Valuable collections were made, however.

The Pacific Coast of America. — Mr. A. L. Pinart, so well known for his researches in Alaska, partly in connection with Dr. W. H. Dall, has received a commission from the French government authorizing him to study the ethnology and languages of the southern races of the west coast of both North and South America. He is at present on a visit to the Indian reservations of Maine and Nova Scotia. Returning thence to San Francisco, he intends to sail for Valparaiso, with a view of determining if possible, besides other things, the source and direction of migration of the native American tribes of both hemispheres.

The Himalayas and their Glaciers. — In Drew's late book, The Jummoo and Kashmir Territories, which is highly spoken of by *Nature*, much is said about the glaciers of the Himalayas; glaciers on a scale, as he says, not to be met with except in the Arctic regions. A glacier which he examined at Basha, in Baltistan, was upwards of twenty miles long, and others are to be met with of much greater extent; indeed to judge from the map, this northwest Himalayan region is one huge net-work of glaciers. The largest of all is the Baltoro glacier, thirty-five miles long, which comes down between two lofty ridges; the northern ridges rise in one spot to the height of 28,265 feet, the peak of that height being the second highest mountain known in the world. And yet, adds *Nature*, these glaciers are a mere remnant, the evidence seems to show, of the glacial covering which at one time spread over the Himalayan region.

Nordenskiöld's Arctic Expedition intends in part to sail up the

Jenesej River with the view of returning to Europe across Siberia, while the other party returns to Norway by sea in the Pröven. The results are exceedingly rich, geographically, geologically, and in a zoölogical way. The Sea of Kara was found to be completely free of ice, and was thus crossed and dredged for the first time by a scientific expedition. The water at the surface of the Kara was so fresh as to kill the animals brought up from the bottom. The investigations on the ocean currents are of much interest. If, says the account in *Nature*, in the northern part of the Sea of Kara, where the water on the surface is almost completely *free of salt*, and at this time of the year very warm, a flask filled with water from the surface is sunk to a depth of ten fathoms, the water freezes to ice. There are thus no warm ocean currents here at any considerable depth below the surface. On the 8th of August the party landed on the peninsula of Jalmal, which separates the Sea of Kara from the Bay of Obi. Here traces of men, some of whom had gone barefoot, and of Samoyede sledges, were visible on the beach. Close to the shore was found a sacrificial altar, consisting of about fifty skulls of the white bear and walrus, with reindeer bones, etc., laid in a heap. In the middle of the heap of bones there stood, raised up, two idols, roughly hewn from driftwood roots, newly besmeared in the eyes and mouth with blood, also two poles provided with hooks, from which hung bones of the reindeer and bear. Close by was a fire-place and a heap of reindeer bones, the latter clearly a remnant of a sacrificial meal.

ARCTIC STATIONS. — Lieutenant Weyprecht has surprised geographers by his common-sense suggestion that hereafter Arctic explorers should aim to erect stations at different points in the Arctic regions where observers should make simultaneous observations, extending over the period of a whole year, with identical instruments and according to identical rules, giving their first attention to physics, meteorology, biology, and geology, and the second place to geographical discoveries. Accordingly, the German Commission on Arctic Explorations has recommended that a principal station be established on the east coast of Greenland, with secondary stations on Jan Meyer Island and the west coast of Spitzbergen.

MICROSCOPY.[1]

A DOUBLE STAINING WITH HÆMATOXYLIN AND ANILINE. — When engaged last autumn in the Anatomical Department of the Oxford University Museum in making microscopic preparations of brain, my attention was especially directed to the staining of the sections.

My first attempts were made with hæmatoxylin and carmine. Of these the latter proved useful for detecting nuclei, but, the protoplasm of the cells remaining almost uncolored, it was impossible to distinguish the shape of the different cells, a matter of the greatest importance where, as in the brain, cells are met with of such various shapes and sizes. Another great deficiency in the carmine-stained sections was the indistinctness of the fibres. In all cases a long time was required for the carmine to take any effect, sixty to seventy hours being insufficient to stain deeply.

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[1] This department is conducted by DR. R. H. WARD, Troy, N. Y.

Hæmatoxylin produced much more successful results. In the first place, the fibres were almost always brought out distinctly; and secondly, the cells with their processes were in many cases clearly defined. But still the cortical substance was frequently insufficiently stained, even after twenty-four hours' immersion in the staining fluid, which, owing to the use of alum, is sufficient to render the preparations too brittle to be easily mounted. The special value of hæmatoxylin consists in the clearness with which it brings out the nuclei of the medullary substance, and the fibres and cell-processes of the cortical substance; its fault is a want of depth in the color of the cortical substance.

Having found aniline blue useful for staining some hardened tissues, I was led to try it in this case. The only virtue that it had was that it stained the protoplasm of the medullary cells very darkly, and always attacked them first; that is to say, its strongest point exactly agreed with the weakest point in hæmatoxylin.

This led me to double staining, and the results were fully up to my expectations. The following is the method of staining which I finally adopted. After from twenty to twenty-four hours' immersion in hæmatoxylin I washed the preparation in weak spirit, and then in distilled water till all the spirit was driven out. I then immersed it in aniline for from half to three quarters of a minute, again washed it in spirit, and after the usual treatment mounted it in Dammar.

The preparation of hæmatoxylin used was that recommended by Frey, *i. e.*, a few drops of an alcoholic solution of the pure crystals added to a solution of alum in water. The latter I have used in the proportion of from two to four grains of alum to an ounce of water. The more alum there is in the solution the more rapid is the staining, but there is great danger of making a thin section too brittle by the use of much alum. The aniline I diluted sufficiently to be able to see through it pretty easily.

The results obtained by this method are most satisfactory. The nuclei already stained by the hæmatoxylin are made of a richer color, while the protoplasm surrounding them is much bluer than the nuclei themselves. In the cerebellum the effect is particularly good, the medullary substance being of a rich purple and the cortical substance of a pale blue, but showing the cells with remarkable clearness. — W. H. POOLE, in Quart. Journ. Mic. Science.

USE OF CARBOLIC ACID IN MOUNTING. — Mr. T. Barnard, of Kew, Melbourne, communicates to *Science Gossip* a reassertion of the successful use of carbolic acid as a substitute for turpentine in mounting insect dissections. A portion of the insect, fresh, is washed, soaked for a few hours in pure carbolic acid, and then mounted in Canada balsam with better effect than from turpentine. By the aid of heat the mounting can be accomplished almost immediately. Zoöphytes, after boiling in water to remove the air, can be successfully mounted in the same manner, being transparent and flexible, instead of brittle as by the ordinary turpentine process.

ECCENTRIC PITH OF CLIMBING PLANTS. — Mr. J. B. Hyatt of Morrisania, exhibited at a meeting of the Torrey Botanical Club a microscopic specimen consisting of a section of the stem of poison ivy, *Rhus Toxicodendron* L., and having the pith near one side "like a hole bored near the edge of a coin." A similar structure is seen in some other climbing stems, as of *Ampelopsis*, though [not in all such; and the editor of the Bulletin suggests, as a mere conjecture, that the extraordinary one-sided thickening may indicate that the plant is nourished by the rootlets imbedded in the bark of the tree.

SCIENTIFIC NEWS.

— The Department of the Interior has issued a circular, prepared by Professor Otis T. Mason, designed to direct the attention of the agents of the Indian Bureau and others to the collection of objects and information for the purpose of representing at the Centennial Exposition the history of culture among the aborigines of America, including the tribes now in existence and those which are nearly or quite extinct.

— We regret exceedingly to hear of the untimely death of Dr. Willemöes Sühm, the amiable and accomplished naturalist of the Challenger party. He was a student and assistant of Professor Siebold, of Munich, when invited to accompany Professor Wyville Thompson. American naturalists may remember his cordial and hospitable spirit. He was a special student of the lower worms and the crustacea.

— At the opening meeting of the Royal Geographical Society, November 15th, Sir H. Rawlinson referred with great satisfaction to Stanley's exploration of the Nyanza, and exhibited a complete chart of the lake, drawn by Stanley.

— Dr. Francisco Todaro from his studies on the tunicate, Salpa, declares that it has an amnion, and is developed in a true uterus.

— A suggestive article entitled Consciousness in Evolution, by Professor Cope, has been reprinted from the *Penn Monthly* for August.

— Science Teaching to Young Children, in *Nature* for November 18th, gives many useful hints on this topic. We doubt, however, whether entomology is rather a "holiday than a school subject," as it seems to us that it can be taught with as much ease and profit as even botany.

— In American Geological Surveys, by Professor Geikie, in *Nature* for November 4th, he speaks in a flattering way of Hayden's U. S. Geological Survey of the Territories.

— Apropos of surveys, we trust that the friends of science and higher education in Massachusetts will vigorously urge the importance of a re-survey of the geology and biology of that State. The vote in the legislature last year was so decidedly in its favor that it would seem as if a second hearing and renewed effort on the part of men of culture might bring about the accomplishment of the plan urged last winter upon the attention of the legislature, and which came so near to definite and favorable action.

— Dr. Burmeister, of Buenos Ayres, is preparing for the Centennial Exposition at Philadelphia a work on the fossil horse of the Argentine Republic, to be published in large folio with eight plates. He is also just sending to press the first volume of his Physical Description of the Argentine Republic.

— The Boston Society of Natural History proposes to send to the Centennial Exhibition an epitome of its museum, including plans of the building and cases. For this purpose fifteen cases, occupying one hundred and five feet of linear measure, will be needed. Besides this, a selected portion of the New England collection, now an attractive feature of the museum, will be placed on exhibition. It is estimated that this portion could be completely illustrated with selections occupying twelve cases, extending eighty-four feet. Work has already begun under the direction of Professor Hyatt, the custodian.

— The *Monthly Weather Review* of the Weather Signal Bureau at Washington, with its maps and quite full record of biological phenomena, will interest students and prove after a series of years of very considerable scientific value. With little effort more contributors might perhaps be enlisted, so that the connection of meteorological phenomena and the sudden appearance of swarms of grasshoppers, for example, could be traced, and possibly insect years be predicted, and thus farmers warned a year in advance of devastations by insects.

— An excellent article on the wild grasses of Nebraska, by Professor Samuel Aughey, appears in the *New York Tribune* for November 26th.

— An elaborate quarto work on the amphipod crustacea (*Gammaridæ*) of the Sea of Baikal, by Dr. Dybowsky, illustrated by fourteen plates (in part colored), has lately been published by the Entomological Society of St. Petersburg.

— A retriever dog, says *Nature*, whose owner was working in the garden of the Bath Institution, lately killed a favorite cat, a frequenter of the same grounds. Having committed this unprovoked murder, the dog deliberately took the cat in his mouth, carried it some distance, dug a deep hole behind some bushes, and, after depositing the cat therein, carefully replaced the earth; and had he not been observed there would have been no evidence of the crime. Shortly after, the dog lost his life by poison, probably a penalty for the offense.

Had the dog lived, would he not, *more canino*, have exhumed the cat for dietetic purposes? — Ed. Naturalist.

PROCEEDINGS OF SOCIETIES.

Philosophical Society of Washington, November 20, 1875. — Dr. Woodward, of the Army Medical Museum, gave an account, illustrated by photographs and illuminated photographic pictures thrown upon a screen, of spurious lines, noted by Dippel, and more lately in a British periodical, as genuine, seen on certain diatoms. The species *Frustularia Saxonica* has transverse lines of extreme fineness, and longitudinal lines had been described by Dippel and others, some asserting that the latter were coarser and others that they were finer than the transverse ones. Dr. Woodward showed very clearly by his illuminated slides, enlarged on the screen forty-five thousand diameters, that the longitudinal lines appeared not only on the diatom but also on the space external to it, and similar lines appeared about specks of dirt on the plate. These could be varied in coarseness by different illuminations of the object. Hence he concluded that they were spurious, and caused by diffraction of light from the midriff, or the edge of the diatom, or any other object in the field. He remarked that the existence of real lines could be determined by the fact that they did not vary in number under varying illuminations or focusing; they were either seen uniformly, or not seen at all.

December 4, 1875. Professor Henry read a short account of some peculiarities of partial loss of vision in circumscribed portions of the retina, which Dr. Woodward explained by a congestion of one, or a part of one, of the *tuberculæ quadrigeminæ* of the optic nerves.

Mr. J. K. Gilbert read a paper on ripple marks as observed by him in the Geological Survey of the Territories under Major Powell. He concluded that the sharper edges of the ripple marks were frequently, if not always, the upper edges, and suggested that the theory of ripple marks as uniformly connected with littoral action did not explain the facts sufficiently. He supposed that they might be formed in deep water by transmission of vibrations through the water acting on the material at the bottom. Professor Henry said, that while it was evident that ripple marks were of different kinds, yet that he considered it certain that their formation was always the result of motion, either of air or water. Major Powell contended for the formation of ripple marks at the bottom of comparatively deep water in which no current existed. Professor Abbe mentioned the observations of an Italian who had come to the conclusion that motion capable of producing ripple marks might be propagated even to the depth of over one hundred fathoms.

American Academy of Arts and Sciences, Boston, November 9. — Mr. Sereno Watson presented a paper on a collection of plants recently made by Dr. E. Palmer, in Guadalupe Island, off Lower California. It was found to contain one hundred and nineteen species, including twenty-one belonging to the higher cryptogamic orders, besides a dozen of probably recent introduction. The number of new species is twenty-two, with two new genera, almost all nearly allied to Californian species and genera. Of those before known, all are Californian, and most have a wide range through that State. The flora of Mexico is scarcely represented, but on the other hand some fresh indications are found of a connection between our western flora and that of South America.

BOSTON SOCIETY OF NATURAL HISTORY. — November 17th. Mr. W. K. Brooks read a paper on the egg and bud development of *Salpa spinosa* (Otto). The life-history of *Salpa* may be stated in outline as follows: the solitary *Salpa* is the female, which produces a chain of males by budding, discharging an egg into each before birth. These eggs are impregnated while the zoöids of the chain are small and sexually immature, and develop into females, which give rise to other males by budding. After the embryo has been discharged from the body of the male, the latter grows up, becomes sexually mature, and discharges its seminal fluid into the water, by means of which it is carried to the eggs within the bodies of younger chains.

December 1st. Mr. S. H. Scudder gave an account of the geographical distribution of *Vanessa cardui* and *V. Atalanta*, two butterflies of wider range than any others known. He attempted to show by the facts at command, and by the distribution of the other species of the genus, that *V. cardui* originated in North America and *V. Atalanta* in Europe. Both the species are now found over either hemisphere, and *V. cardui* over nearly the entire globe. The communication will be given in full in a future number of the NATURALIST.

Professor James D. Dana made a communication on metamorphism and pseudo-morphism in minerals, in reply to Dr. Hunt's strictures on the author's views regarding these phenomena. A Prodome of the Tabanidæ of the United States. Part II. The Genus Tabanus, by C. R. Osten Sacken, was read by title.

NATURAL HISTORY SOCIETY AT MICHIGAN AGRICULTURAL COLLEGE. Notes of Remarks made at late Meetings. — Two roots of the asparagus were found of equal size, about one eighth of an inch in diameter, of which one had grown right through the centre of the other, or the one had grown about the other. They were not fastened to each other, *i. e.*, one was loose in the cavity where it had grown. Roots of basswood and beech were found grown firmly together like a net-work, united in many places. Some of these were over an inch in diameter.

The leaf-cutting bee is very common about Lansing, Mich. It is quite destructive to leaves and petals of roses, the petals of *Petunia*, *Pelargonium*, and many others. The beauty of some beds of flowers is often much injured by them. Their cells are frequently found made of bits of leaves and petals. Quite a number were found in a woolen stock-ing, where they were placed during a few days. In one case there were twenty-seven pieces of leaves to make a cell, and thirteen round pieces at the ends.

A plant of *Portulaca olerarca* (common purslane) weighed one pound and thirteen ounces, and by careful estimate produced about 1,250,000 seeds.

A student brought in a horn about six inches long, and over two inches in diameter, slightly curved and blunt at the apex. The horn was suspended on the abdomen of a sheep, a little to one side. It could be easily slipped around. It was there a year or so before the sheep was killed.

A student had noticed that the dandelion opened and closed four times before the flowers were withered and seed began to appear. On fair days it closed earlier than on cloudy, varying from noon till four o'clock.

BUFFALO SOCIETY OF NATURAL SCIENCES. — November 5, 1875. The following paper was read: A List of the North American Syrphidæ, by C. R. Osten Sacken. Mr. Grote announced that his Check List of North American Noctuidæ was in the printer's hands, and would be issued by Reinecke and Zesch, 500 Main Street, Buffalo, during the present month. Mr. Grote exhibited a specimen of a new species of *Trigonophora* for which the name *Trigonophora V-brunneum* was proposed. It was synonymous with the var. A. of *periculosa* Guen.

December 3d. Dr. Rohlff, the African traveler, was the guest of the evening. The following paper was read: An Illustration of North American Agrotis, by Dr. Leon F. Harvey.

CAMBRIDGE ENTOMOLOGICAL CLUB. — November 12, 1875. Dr. Hagen exhibited queens of white ants (*Termes flavipes*) found by Mr. H. G. Hubbard in Florida. No queens of this species have ever been found before in this country, and but one anywhere. The females are undeveloped, being wingless, but sexually mature. Dr. Hagen dwelt upon the extreme importance of a popular knowledge of the danger to which all wooden buildings are subjected by the presence of these insects, which occur not uncommonly over the country.

Mr. S. H. Scudder spoke of the supposed relation of the "osmateria" of certain butterflies (*Equites*) with the transverse fissure and prehensile organ of the underside of the prothorax in other butterflies.

NATIONAL ACADEMY OF SCIENCES. — Meeting held at Philadelphia, November 3d and 4th. Professor Pumpelly read a paper on the influence of marine life and currents in the formation of metalliferous deposits. As an instance of the presence of the heavy metals in marine animals, he remarked that Bischoff extracted an appreciable amount of silver from only 1¼ pounds of *Pocillopora alcicornis*, one of the commonest reef-building corals. Professor R. E. Rogers accounted for the action of the steam geysers of California by chemical processes at the surface. The heat is caused by the action of air and water upon iron pyrites, generating oxide of iron and sulphuric acid, which readily form sulphate of iron.

Natural History Society of Montreal. — November. A paper by Mr. H. G. Vennor, on the galena and plumbago deposits of Eastern Ontario, was read. Mr. Vennor believes that all the so-called Laurentian rocks which contain Eozoön and many metalliferous deposits (galena, apatite, etc.) are of Silurian or Cambrian age. These rocks are always associated with crystalline limestones. The Huronian group he believes to be next oldest, and lastly there is a great tract of Azoic gneisses, etc., which are truly Laurentian. The true Azoic Laurentian beds, in this view, do not contain metalliferous deposits, nor crystalline limestones.

SCIENTIFIC SERIALS.[1]

Proceedings of the Royal Geographical Society, xix. 7. — Summary of recent Observations on Ocean Temperature, made in the Challenger and Tuscarora, in relation to the Doctrine of a general Oceanic Circulation sustained by Difference of Temperature.

Petermann's Mittheilungen, xxi. 10. — The Russian Amu-Darja Expedition. A Natural History Journey to Patagonia, by Dr. K. Berg. Chinese Travelers of the Middle Ages to West Asia, by Dr. E. Bretschneider. Journey to Araguaya by Dr. Couto de Magalhaes in January, 1865. Notes on the Oasis El-Chargeh, by Dr. Schweinfurth. C. Weyprecht's Survey of the Northern Coast of Nowaja Semlja in September and October, 1872. October 18. Paul Solcillet's and Largean's Travels in the Sahara and to Soudan, by Gerhard Rohlfs. Pictures from the Far North, by Karl Weyprecht. The latest Travels in Australia, by E. Behm. The Spread of the Egyptian Power in the Upper Nile and its Geographical Results. Supplementary number, 34. Journey through North Africa from Kuka to Lagos, by G. Rohlfs. 35. The Population of the Earth, by Behm and Wagner. 36. Four Addresses on the Caucasus, by G. Radde. 37. Carl Mauch's Journey in the Interior of South Africa, 1865–72.

The Geographical Magazine. — November, 1875. The Arctic Expedition, iii., iv. A Glance at the Results of the Expedition to Hassar by H. P. Lerch, by H. Yule. The Voyage of the Challenger, by J. E. Davis. Recent Journeys in Paraguay, by Keith Johnston.

Bulletin de la Société de Géographie. — September, 1875. Rise and Fall of the Coast of France, by Jules Girard (records the discovery, between Vannes and Nantes, of Druidical monuments, under the water). Geography of the Athabaskaw-Mackenzie, by l'Abbé Petitot.

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[1] The articles enumerated under this head will be for the most part selected, so that the entire contents of the journals are rarely given.

AMERICAN JOURNAL OF SCIENCE AND ARTS. — December. On Southern New England during the Melting of the Great Glaciers, by James D. Dana. Notice of new and interesting Coal Plants, by E. B. Andrews.

ARCHIV FÜR MIKROSKOPISCHE ANATOMIE. — October. The Genus Loxosoma, by Oscar Schmidt. On some Rhizopoda and allied Organisms, by L. Cienkowski. The Locomotive Apparatus of Infusoria, by H. Simroth. On a new Microtome, by P. Schiefferdecker. The Organs of Hearing of the Heteropoda, by C. Claus.

NATURE. — October 28. Notes from the Challenger (describing a colossal hydroid Polyp), by G. J. Allman. November 4. American Geological Surveys, by A. Geikie. Müller on Bees and Flowers, by J. Lubbock. November 11. Evidences of Ancient Glaciers in Central France, by J. D. Hooker.

JENA JOURNAL OF SCIENCE (JENAISCHE ZEITSCHRIFT, ETC.). — May. The Ontogeny of Fresh-Water Pulmonates, by Carl Rabl. Contribution to the Knowledge of Termites, by F. Müller. *Hæckelina gigantea*, a Protist of the Group of Monothalamia, by E. Bessels. July. On the Developmental History of Helix, by H. von Jhering. The *Gastrula* and the Segmentation of the Eggs of Animals, by E. Haeckel.

ARCHIV FÜR ANTHROPOLOGIE. — August. Notes on the Innuit of Smith's Sound, etc., by E. Bessels. Traces of Men in the Interglacial Deposits of Switzerland, by L. Rütimeyer.

JOURNAL OF ZOÖLOGY (Siebold and Kölliker, editors). — July. New Contributions to a Knowledge of Parasitic Copepods, by C. Claus. On the Results of Studies on the Conjugation of Infusoria and Cell Division, by O. Bütschli. Egg-Segmentation and Larval Development of Phascolosoma, by E. Selenka. On the Structure and Budding of Loxosoma, by H. Nitsche.

ANNALS AND MAGAZINE OF NATURAL HISTORY. — London, December. Relation of the Canal-System to the Tubulation in the Foraminifera, with reference to Dr. Dawson's Dawn of Life, by H. J. Carter. Contributions to the Study of the Chief Generic Types of the Palæozoic Corals. By James Thompson and H. A. Nicholson.

ANNALES DES SCIENCES NATURELLES. — Paris, October, 1875. Study of the Annelides of the Gulf of Marseilles, by A. F. Marion and N. Bobretzky.

THE GEOLOGICAL MAGAZINE. — London, December, 1875. The Cause of the Glacial Period in Britain, by Charles Ricketts. Did the Cold of the Glacial Epoch extend over the S. Hemisphere? by F. W. Hutton. A Chapter in the History of Meteorites (part xii.) : The Conclusion, by W. Flight.

THE

AMERICAN NATURALIST.

Vol. x.— FEBRUARY, 1876. — No. 2.

INDICATIONS OF THE ANTIQUITY OF THE INDIANS OF NORTH AMERICA, DERIVED FROM A STUDY OF THEIR RELICS.

BY DR. C. C. ABBOTT.

THE stone implements of the Indian long since lost in the chase, broken in the conflict, or discarded when metals were introduced, as we now gather them up singly or by the score, seem to give us no clew to those most interesting of all questions connected with them, When were the first of these stone implements shaped? How many centuries have passed since the Indian first reached our shores, and armed himself with these rude weapons?

That isolated specimens of relics, however occurring, should be valueless in this respect is quite natural, considering the many circumstances which might arise to place single implements in the most unlooked-for places; but on the other hand, when an opportunity is had of securing nearly the entire series of relics left by a departed race in a single locality, and of examining them, not simply on the shelves of a cabinet, but as they lie upon and in the ground, then there is an opportunity afforded of gathering facts concerning them other than the extent of their variation in shapes and uses; and particularly may we learn something of the relationship they bear to each other with reference to the vexed question of their antiquity.

In previous articles in this journal (vol. vi.) I have briefly called attention to the vast numbers of relics found in Central New Jersey, and drawn a distinction between the ruder and the more elaborate forms, considering the former strictly paleolithic implements; but that from this stage of culture to that of the polished stone age there had been an unchecked development, a gradual merging of the one into the other condition. Subsequent

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studies have led to a modification of this view, and a separation of the two classes of relics as traces of distinct peoples. This subject I propose to dwell upon at some length in a subsequent article, and desire to call attention now to what I believe to be positive indications of the very great length of time during which the Indian occupied New Jersey, as derived from the study of thousands of stone implements gathered by myself.

Unless some very marked geological change occurred, obliterating every vestige of the former surface of the country, lost paleolithic implements would naturally occur, scattered about, and what more probable than that men of a later period should occasionally pick up, preserve, and utilize them? The difference between a paleolithic and a neolithic flint hatchet is not as great as that between an ancient stone and a modern metal hammer; and Nilsson[1] refers to a stone hammer of undoubted antiquity being long used by a carpenter, who had put it to uses similar to those of its prehistoric owner. When, therefore, among true Indian relics that occasionally are found lying together as the series described by the writer in this journal,[2] that marked the site of a "homestead of the stone age," there happens to be "rudely chipped implements" associated "with some of the very finest wrought stone weapons and arrow-heads," it is not necessary to conclude that the latter were made at the same time as the others, for we are not sufficiently familiar with the every-day life of the stone-age Indian to assert that he could have found no use for these rude productions of his predecessors, on the one hand, or that he did not gather them up for use, or work them over into better forms, when they happened to be met with. Inasmuch as these rude relics that are *intimately* associated with newer relics invariably exhibit a greater degree of weathering and decay than accompanying implements of the same mineral, it is not difficult to separate them; and whatever the use to which they may have been put, it appears certain that they were occasionally gathered — veritable relics of a departed people then — by the Indians for some practical purpose.

As arrow-heads are the best known form of Indian relics, and as they certainly outnumber all other forms, and are abundant frequently where no other pattern is found, they afford by reason of their numbers excellent opportunities for determining various questions concerning the condition and degree of culture of the people using and making them. I will therefore first refer to them, in endeavoring to point out the indications of the antiquity of the Indian.

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[1] Stone Age in Scandinavia, 2d ed p. 69.

[2] Vol. vii., p. 271.

On examining a complete series of arrow-heads from one locality, we find that whatever mineral was available was utilized in their manufacture, and on the sites of arrow-makers' workshops not only is there a vast accumulation of chips of the more popular minerals for arrow-heads, but quantities of water-worn pebbles from the river and brook beds, which have been split in two, or otherwise tested, to see if by the first fracture they gave promise of being available. Again, certain minerals seemed specially adapted for a given pattern of arrow-points, and were used almost exclusively for it. We have here certainly an unquestionable indication that the art of arrow-making had been progressive, whether the progress was made while the Indians were in this country, or acquired previously. In either case, the progress had been made; and when we find rude arrow-heads in considerable numbers, of plain patterns, scattered singly about fields and forests, it is quite conclusive that these are the forerunners of the former, — the elaborate jasper specimens, — and that the progress in the art of arrow-making was acquired during the Indian's occupancy of this territory. As this was very slow, the date of his arrival reaches back into strictly prehistoric times.

Having seen that different minerals were used by the Indians in arrow-making, let us consider in detail what evidence there is of great improvement in the production of these implements. The poor specimens of themselves do not simply indicate, as might be claimed, that they are the work of beginners in the flint-chipping art, for they are found in such localities and under such conditions far too often for one not to see that they are the weapons of an earlier time than are the more elaborately wrought forms found near them. In a country overgrown with forests, where there is annually a vast deposit of dead leaves, there necessarily is a steady increase in the depth of the soil by the deposition of a thin layer of vegetable mold. This increase I believe to be about one one hundred and twenty-eighth ($\frac{1}{128}$) of an inch per annum, in beech, oak, and chestnut woods. If on examination of the undisturbed soil of such forest tracts we find jasper and quartz arrow-heads at a depth of ten inches which are large, not acutely pointed or symmetrical, and of the simplest patterns, as the leaf-shaped or triangular; and smaller, symmetrical, stemmed, barbed, acutely pointed specimens two or three inches deep, as a rule; then I submit it is quite certain that the former are about thirteen centuries old, and the latter ranging from two and a half to four centuries. This is what really occurs in New Jersey, and in part I rest the claims of the Indian's antiquity thereupon.

Again, in the river flats that are yearly and semi-yearly overflowed, this same condition obtains; and the deeper in the deposits — which are constantly increasing in depth, and have been since the river assumed its present dimensions — that we find these arrow-heads, while mineralogically the same with the very finest, they show less skill in the workmanship. This applies, as we shall see, to all other forms and varieties of weapons, domestic implements, and ornaments; and gives us evidence of an improving savage, who subsequently reached a somewhat higher stage, beyond which he has no capability of going.

The grooved stone ax is a form of Indian relic that is a marked feature of the stone weapons of the Indians. They are moderately abundant everywhere, and tens of thousands are probably still lying in the soil. I have knowledge of one field of twelve acres from which have been already gathered one hundred and thirty specimens, and every plowing brings others to the surface. These axes give us the same evidence of gradual improvement I have pointed out as existing in the case of arrow-heads. Weapons of this pattern are strictly a neolithic form, the groove making it a polished or ground stone implement. They are never made of "flaking" material, but are pecked or hammered into shape, then smoothed or polished. In the apparently more ancient graves, these axes are pebbles from the river bed, that have acquired something of an ax shape. The edge was first hammered and then smoothed by rubbing, and a roughened circle made about it, at or near the middle of the stone.[1] Derived from such a rude relic we have, in later times, very carefully grooved specimens, many with the groove faced with high ridges, that give the depression a double depth. The edge is a marvel of accuracy in tool making, being as correctly formed as in the most elaborate steel ax of the present time, although of course not as thin in the blade, and as sharp. These perfect stone axes occasionally are turned up in plowing, but most frequently are found in graves, associated with finely wrought jasper spears and other weapons; but never in the oldest graves, or the deep, undisturbed soil. Examination of the mud of the river flats, and other localities where analogous changes are in operation, yields precisely the same results, as to the degree of excellence of workmanship in comparison with the depth at which they occur, as in the case of arrow-points, and I draw the same conclusions in the one instance as in the other.

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[1] Stone tools, as hammers, whetstones, etc., indicative of the method pursued in making these and other weapons, are very abundant in some localities.

Before referring to pottery and its bearings on this question, I desire very briefly to call attention to an interesting point connected with every large series of stone implements from a given locality; that is, that there are very many forms of such relics that are never found except of advanced workmanship. In proportion as the implements of the Indian were of primitive make, they were few in forms, one form answering for a variety of purposes; but advance in the art suggested variations in shape to meet particular uses; and so, in proportion as we find a specimen of a specialized shape, we find it elaborately wrought and of fine material. A rudely nicked flint flake was never yet met with that there is a shadow of reason for believing answered as a saw, and was thus used. The wavy, saw-like edges of many spear-heads doubtless suggested that tool; and carefully toothed, thin flakes of jasper are frequently found,[1] that unquestionably were made for sawing, and for this use only. The large "scrapers," especially those occurring in fresh-water and marine shell-heaps, are not generally very carefully shaped, and the majority are made of easily worked material. Like arrow-heads, they give evidence of gradual improvement. With the ruder shapes of this implement, just referred to, there are never found associated the delicately chipped, diminutive "scrapers," as they are usually called, which were certainly intended for other uses than cleansing skins. These miniature "skin-dressers" were doubtless suggested by the typical scraper, and so are of later origin. They are met with upon the surface of the ground, and, whatever their use, are simply another instance of what I stated concerning arrow-heads and axes. If correct in my conclusions with reference to Indian relics as a whole, the bearing of the above remarks regarding specialized forms, such as described, on the question of the antiquity of the Indian, is obvious.

There is no one class of relics by which the general advance in art can be estimated better than that of pottery. This, in a more or less fragmentary condition, occurs associated with neo-

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[1] In a fresh-water shell-heap of limited dimensions, situated on the bank of a small creek, has been found a jasper saw seven inches in length, and near it several tibiæ of deer that had evidently been cut in sections with this implement.

[illegible] same implements wherever found, either on the s
the soil or buried in graves. This association is a relia
as the age of accompanying relics, especially when me
graves, for superior ware would be chosen to contain
buried with the body. I have invariably found in tl
which from indications irrespective of their contents
were of considerable antiquity, that the contained reli
with the internal evidences; and especially is this tr
pottery. It is very coarse and free from all attempts
decoration when associated with coarse, unskillfully
weapons; and elaborate, highly decorated,—by figures
patterns and colored,—and fine in its composition wl
in graves containing carefully wrought, artistic jasper s
arrow-points and highly polished, symmetrical celts
The same obtains with pottery that has been long
deeply buried by the accumulating soil of periodically s
lands, when compared with that found nearer and upon
face.

The rude pottery, and evidently the older, is simp
earth with no admixture of foreign matter other than
were accidentally incorporated, such as small pebbles
pieces of wood. It is easily broken, free from orname
[illegible] sun-burnt only.[1] Always thick, and usually un
size of such rude make could have been of but limited
judging from the fragments, were always small roun
bowls, never contracted at the opening as the majorit
vases and urns of later times are. The finer and late
is made of carefully selected clay, is mixed with finely
ground shells, is comparatively thin, of uniform thick
often very elaborately decorated with curved lines, dots
and parallel lines, singly or combined. Some fragme
have gathered give grounds for believing that by va
proportions of the ingredients of the mixture the maker
termine the color, as some of these fragments are of a bri
red color, others of a delicate pearl tint, and a third va
deep, dark purple. A careful comparison of a large
specimens gathered from a single neighborhood, made

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[1] From circumstances to which I cannot more than allude now,
believe that the first pottery was baked by being plastered over one he
of a stone previously heated. The heat from the stone and exposure to
sulted in an unequal burning, the inside of the vessel being harder than
surface.

tion with laborious examination of the surroundings and circumstances of the finding of nearly every fragment, — thousands in number, — makes it evident that a very gradual improvement was acquired in this art by the Indians during their occupancy of this territory.

It is unnecessary to give additional facts indicating that the duration of the occupancy of this country by the Indian was marked by a considerable improvement in his condition, as shown by the vast superiority in workmanship of much of the stone-implement work over the rest (exclusive of paleolithic implements), and therefore of necessity that that occupancy was of long duration.

The question now naturally arises, How old are the oldest Indian relics? Only comparative antiquity can be determined. There is no starting-point from which to begin a positive calculation, and I purpose only to show that the antiquity is real and great, without endeavoring to determine its limits by an array of figures. I have already done this in reference to the arrowheads and axes. There are, however, one or two considerations which have some bearing on this question.

There occasionally are brought to light traces of human habitations which, judging from their contracted limits, were sites of dwelling-places of a single family, or at most a small group of people. The hearth, readily recognized by the charcoal and ashes, the fact of subsistence on animal food by the bones of mammals, birds, and fishes, and the occupation, if an arrowmaker, by abundance of flakes and chips, — all are there. There is nothing wanting to tell the story of the lives of the former occupants of the place. Such habitation-traces, if I may call them thus, differ among themselves in two ways: by the greater or less depth beneath the existing surface of the soil, and by the character of the finish of the contained relics. There is in this case, too, a repetition of what has been thrice stated already, nearer the surface, finer the finish; but the depth of soil above these ancient hearths can, I think, be measured so as to give an approximation to the age of the inhumed relics, whether in the case of deposition from the muddy waters of the semi-annual freshets, or of the slow decomposition of forest leaves. The freshets of the Delaware River, occurring usually twice a year, deposit about one two hundred and fifty-sixth ($\frac{1}{256}$) of an inch per annum, and hearths and shell-heaps occur as deep as two feet below the present meadow surface. Such traces of human habitations, if there have been no other causes in operation to bury them, are about sixty centuries old. If we double the deposit from the water in a given time, even then twenty-six hundred years had passed by since the abandonment of these little shell-heaps and "homesteads" when Columbus discovered the western world; but I believe the former estimate to be much nearer the truth.

I have already referred to arrow-heads which I considered to be about thirteen centuries old. They were far from being rude in workmanship, although not of the most elaborate finish. If we grade a series of a thousand specimens from one locality into three or four, say four, degrees of excellence, such specimens as I have estimated as probably thirteen centuries old will stand as number three in the series. If the acquirement of excellence in flint chipping was uniform, the first and rudest of the arrow-heads assignable to the neolithic Indian dates back twenty-six centuries previous to the specimens graded as number three. All things considered, from thirty-five to forty centuries ago, at least, I believe to be the point in the past when the Indian appeared in what is now New Jersey; but it is by no means improbable that in even more remote times he found his way to the Atlantic coast.

Prior to this were made and used still ruder implements of stone. Deep in strata of sand and gravel underlying the soil, they are occasionally met with. Throughout this essay I have referred to them incidentally as "paleolithic" implements. In conclusion, I will briefly state that from the foregoing remarks it will be seen that one of two considerations must be true. Either the paleolithic implements belonged to the same people as the neolithic forms, or they are the production of a distinct people. When it is remembered that the Indians preserve a tradition of being a usurping people, and credence is given to this fact as stated by them according to numerous authors, the relics now found seem corroborative of such a tradition, and these paleolithic implements, so different from the others in many respects, remain as the only trace of that still older people, the autochthonous race of these shores who were in sole possession when driven away by the incoming Indians, whose own stone implements at the time were but little more elaborate than those of the expelled or subjugated people, but which, as century after century rolled by, became the beautiful specimens of the flint-chipping art which we now find scattered over our hills, along our valleys, and mingled with the pebbles of our forest brooks.

HAECKEL'S GASTRÆA THEORY.

BY ALEXANDER AGASSIZ.

PROFESSOR HAECKEL has just published in the *Jenaische Zeitschrift*[1] a second paper on the gastræa theory, devoted to answering the many attacks to which it has been subjected. It is fortunately free from the personalities which disfigure so many of Haeckel's productions, and consists mainly of new theories and new interpretations of well-known embryological facts. Haeckel now endeavors by a most ingenious theory to explain the phenomena of segmentation, which (according to him) conceal the original unity of the gastræa in the different classes of the animal kingdom. As Haeckel now presents the gastræa theory it would be difficult to recognize it as he and his followers formerly understood it.

It is unfortunate that Haeckel should feel obliged to coin so many new terms, for unless the reader can throw himself, heart and soul, into Haeckel's position, he will hardly feel inclined to master the delicate shades of meaning which a difference in prefix or termination involves. They undoubtedly contribute to the terseness of the text, but are so numerous that the reader can scarcely be expected to carry in his mind the necessary vocabulary, much of it dating back to the Generelle Morphologie.

Haeckel has made an important admission in going back for his starting-point to the egg (as the opponents of his theory urged), and attempting to trace how far segmentation can be influenced by natural selection; he has of course seen the difficulty, of which all embryologists are aware, of accounting through such a cause for the vital divergence observed in the segmentation of closely allied groups, leading eventually to the same result. It is difficult even in the wildest flight of imagination to frame a theory to account not only for these radical differences of development in the ancestral eggs, living in the same medium, subject to identical influences, but also for their transmission by inheritance. Haeckel's explanation of the causes which have led to the concealment of the descent of the gastrula is that only those embryonic processes which can be traced directly to a former independent ancestral form, and can be inherited, are of primary importance for the recognition of genetic connection, while those embryonic phenomena which are due to adaptation of the embryo or larval condition can claim only a very secondary importance. It is by palingenesis and cenogenesis, the terms he applies to primary and secondary embryonic phenomena, that he accounts for the divergence observed in the earlier embryonic stages. Whether we agree with Haeckel or not, his paper cannot fail to be most suggestive, as this is the first attempt to tabulate the early embryonic stages of the egg in the different classes of the animal kingdom, with a view to account for their difference on the theory of natural selection; the more interesting, coming as it does from the investigator who first tested the theory of descent by the monographic study of a great group. It is not our purpose to describe the many subordinate phenomena, either of palingenesis or of cenogenesis, quoted by Haeckel; we merely wish to call attention to the dangerous path he treads when he explains anomalies as falsifications of the record in either time or space. When we have to resort to such devices, no explanation at all is fully as satisfactory.

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[1] Die Gastrula und die Eifurchung der Thiere.

Armed with this new instrument of investigation, Haeckel carefully compares the different modes of segmentation resulting in the gastrula, to which he had already alluded in his Anthropogenie. He then takes up the same subject for the several classes of the animal kingdom, and treats it with his usual ingenuity, and closes with the phylogenetic interpretation to be assigned to the early stages of embryonic development. Of these he recognizes five as of primary importance: the "monerula," or the first stage of metazoan development; the second stage, representing the egg as commonly understood, which he calls the "cytula;" the third, the "morula," or mulberry stage; the fourth, the "planæa" (formerly known as "planula," though very different stages were often spoken of under that name); and the fifth, the "gastrula."

This paper is accompanied by two plates of diagrammatic sketches copied from various authors, representing the segmentation and gastrula of various invertebrates and vertebrates. Haeckel gives in addition original figures of the same stages in a crustacean, an annelid, a mollusk, and a bony fish. It is a great pity that such a skillful draughtsman should give such untrustworthy figures to illustrate so fundamental a theory, and quietly fall back upon the righteousness of his cause. His figure of a fish embryo has no value as a copy of nature; it is a diagram simply. Such an embryo may exist, but the distrust naturally felt of such fictitious illustrations, by all who are familiar with a portion of his subject, naturally extends in the first place to all his figures and lastly to his whole theory.

The plate devoted to the segmentation of the bony fish is particularly important, as it gives us a totally different interpretation of the formation of the embryo from the one usually accepted. Haeckel's observations were made on the pelagic eggs of what he calls a Gadoid. Judging from closely allied eggs we have had the opportunity to study on our coast, we should say they were more probably Cottoid eggs.

It may not be out of place to call attention to the great abundance of pelagic fish eggs readily obtained, in all stages of development, during the breeding season of a number of our common marine fishes. With the exception of the very earliest stages of segmentation, only to be obtained, owing to the rapidity of the process, by means of artificial fecundation, I know of no method so readily accessible for studying the embryology of fishes as that of collecting pelagic fish eggs. I have myself studied more or less completely the embryology of our sea-perch, tautog, two species of sculpins, two species of flounders, a Motella (young Phycis?), our blue-fish, menhaden, butter-fish, goose-fish, and several other species of uncertain origin. These pelagic eggs are by no means as delicate as eggs usually laid on the ground and obtained by ordinary artificial fecundation, and the young embryos can generally after hatching be retained alive for a considerable period.

THE SUMMER BIRDS OF THE WHITE MOUNTAIN REGION.

BY H. D. MINOT.

AS in this article I mean to speak of the birds found in summer in the region of the White Mountains, I may state that my information in regard to them has been drawn from observations made at Conway and Bethlehem. At North Conway, where I spent several weeks in the year 1872, I observed, through whatever part of the neighboring country I went, an almost entire absence of birds. That township, owing to its situation in a valley to the south of the White Mountains, and other causes perhaps, contained, to my knowledge, few birds beside the ruffed grouse, a few ducks in the rivers, sandpipers, one pair of hawks, one pair of kingfishers, a few robins, and the proverbial village swallows. But Bethlehem, the highest village of New England, sixteen hundred feet above the level of the sea, blessed with a cool, invigorating climate, situated to the westward of Mount Washington, yet practically among the hills, in many places covered with large tracts of genuine old New Hampshire forests, and overrun with brooks, contains thousands of birds in summer, and these birds belong partly to the Canadian fauna. Therefore this article has been written partly to illustrate the distribution of that fauna, but partly, however, for other purposes. When I first came to Bethlehem, two years ago, I found but one pair of robins in the township, but I am glad to see that there are now several pairs, one of which, I have been told, built their nest a little while ago on the top of a long pole, which stood without support in an open hen-yard. Several robins have retired from the village and built their nests in the woods and haunts which seem more appropriate to the other thrushes, of which the Swainson's thrushes are by far the most common, and correspond to the familiar wood thrushes of Massachusetts. The olive-backed thrush sings very sweetly, very much like the wood thrush, but not so finely nor quite so exquisitely; picks up insects of various kinds, as food, among the branches of the trees in the thick woods, particularly woods drained by swamps or streams, and builds its nest in young spruces, from six to ten feet above the ground, laying in these three or four eggs, which are much like those of the scarlet tanager. As with many other birds, it often rears, when undisturbed, two broods of young in the course of the summer. Hermit and Wilson's thrushes are not at all common, and I have met with but a very few in Bethlehem, especially of the former. I do not think that I have ever seen any brown thrushes.

I have seen one or two cat-birds, but these latter, as is the case with the blue-birds familiar to me at home, are to be ranked among strangers in this place. I have been greatly pleased to meet a pair of golden-crowned wrens here, which inhabit a large tract of white birches (the home of chickadees). I found them with a family of young in August, last year, as well as without young in July, this year, though I have not yet been able to find their nest. Chickadees, brown creepers, and both kinds of nuthatches are summer residents, as house wrens also are occasionally. But the winter wrens are of more interest to me than these latter, and I have found a great many in the valleys here, though I inferred from a remark of Dr. Brewer's, before coming to Bethlehem, that they inhabited only the sides of Mount Washington, and like altitudes. These birds are ever busy about the fallen trees and brushwood of the forests, and from the top of some dead limb often pour out a shrill, hurried song of wonderful power and great liveliness. The woods frequented by these wrens, as well as many other forests, abound with warblers, only a few of which regularly pass the summer in Massachusetts, whereas most of them can no doubt in summer be found in Canada. The black and white creepers are not common; but the little blue yellow-backed warblers are quite common, usually busily engaged among the tree-tops, their habits and their song being the same during their migrations through the neighborhood of Boston in the spring. They build their nests chiefly in the drier woods of maples, chestnuts, hemlocks (and oaks), as they do in Massachusetts, when they occasionally pass the summer there. In such woods, and the damper spruce swamps, I often see the black-throated green, or hear his familiar notes, which are sometimes blended with the less musical "*zwee-zwee zwee-zwee*" of the black-throated blue, which refrain is repeated in a peculiar tone, with a rising inflection. The two kinds of warblers, however, which I have been most surprised to meet here are the yellow-rumps and the prairie warblers. I saw a pair of the former among some spruces, my attention having been called to their song, which, by the way, I have heard again and again in the spring migrations of these birds, and which resembles more or less a weak imitation of the purple finch's song. The prairie warblers I have twice met in different woods, and I found in a low spruce, in a dark wood, one of their nests, which, as well as the eggs in it, differed very much from all other specimens in my cabinet. I was rather amazed to find the former species so far to the south of what I supposed to be their range in summer, and the latter species in dark forests, a hundred miles northward of certain sunny pasture-lands in Massachusetts which have usually been considered the northern limit of their distribution.

The Blackburnian warblers are also summer residents here; and though the brilliant coloration of the male is an ornament to the place in which he lives, yet his simple notes, "*wee-seé-wee-seé-wee-seé*" (to which a terminal "*wee-seé-ick*" is occasionally added), are hardly an addition to the various musical charms of the place. I now and then meet black and yellow warblers in the woods, and hear or see chestnut-sided and Nashville warblers in more open lands; but these latter are rare. "Black-polls" belong, I think, to Northern Maine rather than to Northern New Hampshire, and I have met but two here, though I have found several old nests in spruces and hemlocks, which I have attributed to these birds. The Canada fly-catchers, on the contrary, quite commonly inhabit the cooler woods, where I have often watched the male catching insects and caterpillars with great dexterity, sometimes collecting a dozen or more in his bill, doubtless to feed his mate or young with. The Maryland yellowthroat, however, is by far the most common warbler at Bethlehem, frequenting woods and roadsides alike, never shy but always watchful; whilst the equally familiar "red starts" are also tolerably common, and I often hear them singing in company with others of their family in the depths of the forests. Though I have seen no water thrushes here, yet in the deep woods, since there are no dry groves near the houses, I occasionally hear the familiar chatter of the wagtail (*S. aurocapillus*), generally near some water-course, however, rather than in dry woods.

Whenever I return from a long walk through the haunts of these various warblers which I have just enumerated, I invariably see many cedar-birds on the roadsides and in the orchards, and when I get to the village I can always see there about me all the swallows, including the so-called chimney swallows (which cannot, however, by modern classification claim any near relationship to the true *Hirundinidæ*). Of these swallows the sand martins have established themselves at a sandbank near the central cluster of houses, and have become fairly colonized; whereas the cliff swallows and purple martins (the latter of which a friend reports having seen) have but just made their appearance in the township (for the first time, so far as I know, though perhaps one or two pairs may have spent the last season here, unnoticed by me). About the village both red-eyed and warbling vireos pass the summer (of the latter only one pair); and in the woods I often hear the cheerful warble of the red-eyed and solitary vireo, the latter of which is very rare, whereas the former is quite as common as about Boston, and constantly reminds me of a more familiar neighborhood. Grateful for the society of these vireos, I am thankful that this place is not pestered with their cruel and destructive relatives, the murderous shrikes, of which I have seen no bloody traces as yet.

The finches are well represented at Bethlehem, both by species familiar to us near Boston in summer, and by others. Perhaps the most common representatives are the goldfinches, which frequent pastures, roadsides, and gardens, sometimes, by the way, not laying their eggs until the second or third week of August, since in Massachusetts they habitually build their nest very late in the season, and here all bird sgenerally breed two, three, or four weeks later than they do two degrees further south (within thirty miles of the shore). The purple finches are rare; but five kinds of sparrows are common, and make up this deficiency; of these the song sparrows, bay-winged buntings, and savannah sparrows frequent the fields, from which I constantly hear their songs — the more familiar music of the two former, and the quaint, drawling "*chip-chirr*" or "*chip-chip-chee-chee-chirr*" of the savannah sparrows. "Chippers" are quite common in the village, and all day long the clear, exquisite whistle of the Peabody-birds (or white-throated sparrows) is heard from the woodland which they inhabit. The snow-birds frequent the woods and hill-sides in many places, and there gain a livelihood by finding food on the ground or about fallen logs and standing stumps, over which they are constantly running; and the indigo-birds are common in pasture-land, whence I often hear their familiar song, sometimes joined with that of the chestnut-sided warbler, or some other denizen of their haunts.

The *Icteridæ* and *Corvidæ* are represented each by two species, the former by the bobolinks and a stray pair of golden robins, the latter by crows (in no great abundance) and a very few blue jays, whose screams I hear but occasionally from the woods. (Thus the number of oscine birds which I remember to have seen at Bethlehem is fifty, of which sixteen are not regular summer-residents in Massachusetts. The number of *Clamatores* is six, and the total number of *Passeres* fifty-six, of which forty are also regular summer residents in the neighborhood of Boston.) The representatives of the *Clamatores* are the following fly-catchers: the kingbirds, the great crested fly-catchers, the pewees, which are not at all abundant, the olive-sided fly-catchers, the wood pewees, and the Traill's fly-catchers, which inhabit much the same places as do the wood pewees, preferring, however, rather drier woods, where, from the upper branches, on which they have taken their post, they utter their characteristic "*pu-ee*."

Belted kingfishers live near the streams and mill-ponds; and in the forests which border upon these, live the humming-birds, which rarely come to the gardens in the village, preferring the woods to open grounds, as I believe that they often do in more cultivated and more thickly populated districts. Occasionally, whip-poor-wills enliven the night with their cries, and night-hawks very often fly about at dusk, sometimes in company with the few chimney swallows which live in the village. I have once or twice heard the notes of the (yellow-billed?) cuckoo from the shrubbery which borders upon the woods, where live the hairy woodpeckers, — whose relations, the downy woodpeckers, I do not remember to have often seen here, — and also the three-toed woodpeckers (*Picus arcticus*), of which I have seen but one pair; the yellow-bellied woodpeckers, regarding which I may make the same remark; the great log-cocks (*H. pileatus*), which particularly affect old forests and backwoods; and the common flickers (*Colaptes auratus*). (These birds are the seventeen representatives of the Picarian group, and five of these do not regularly breed in Massachusetts.) I have seen no birds of prey, except occasionally four hawks: red-tail, sparrow-hawk, sharp-shinned hawk, and marsh hawk; a golden eagle; and as to the game-birds, there are wild pigeons, ruffed grouse, one pair of woodcock, no snipe, but a few ignominious sandpipers (*T. macularius*; also *R. solitarius ?*) in their stead. With these five latter birds and one accidental heron (once seen flying over the valley) I close this perhaps imperfect list of the eighty-three birds which are summer residents at Bethlehem, twenty-one of which are not summer residents in Massachusetts, unless irregularly so. Many of these birds represent a Canadian fauna; some belong to that and the Alleghanian fauna too, whereas a few belong entirely to the latter. These facts show that Bethlehem is situated on the line between these two faunæ, and contains an interesting admixture of birds which belong to different areas of distribution.

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THE HISTORY OF THE ORIGIN AND DEVELOPMENT OF MUSEUMS.

BY DR. H. A. HAGEN.

COLLECTIONS of objects of natural history are indispensable nowadays to the naturalist in his studies. The advantage of such collections to the student is indeed very obvious, as the study of natural history consists chiefly in comparison. Every description, every observation, is more or less a comparative one, even if the object compared is not mentioned; and it is easily understood that richer and more complete collections help to a more complete study, a more perfect work. The history of the origin and development of collections of natural history is not devoid of interest, perhaps even profitable for science and for the important question as to which would be the most convenient arrangement of a collection. The materials for such a history are scanty, for those of ancient times are nearly wanting. But the impossibility of believing that knowledge in natural history would be attained and furthered without collections induced Professor Beckmann to express the opinion in a short but interesting paper on this subject, some ninety years ago, that the origin of such collections was to be found in the old custom of keeping curious and remarkable objects in temples. This opinion gains some ground, as the medical sciences are considered to have originated in the written reports of convalescents about their sickness, and the remedies used, which were posted in the temple of Æsculapius for everybody's instruction. There are some interesting facts quoted by the classic authors. The skins of the hairy men from the Gorgades Islands, brought home by Hanno's expedition, were still preserved in the temple of Juno, three hundred years after Carthage was destroyed. The late Professor J. Wyman ingeniously suggested that they might be the skins of the gorilla. The horns of the Scythic bulls, exceedingly rare, and alone capable of preserving the water of the Styx, were given by Alexander the Great to the temple of Delphi. The horns of the renowned obnoxious steer from Macedon were presented by King Philip to the temple of Hercules; the abnormal omoplate of Pelops was in the temple at Elis; the horns of the so-called Indian ants, in the temple of Hercules at Erythris; the crocodile brought home by the expedition to the sources of the Nile, in the temple of Isis at Cæsarea. A large number of similar cases are quoted in Professor Beckman's above-mentioned paper. The choice of places devoted to religious service, for such deposits, was very appropriate, every spoliation of them being considered sacrilege. So it happened that such curiosities were preserved many centuries, and the not infrequent additions in such a space of time formed at last a somewhat considerable collection, open at any time and to everybody. The variety of prominent objects was certainly instructive to the observers.

Apollonius saw with wonder in India the trees bearing the different kinds of nuts he had seen before preserved in the temples in Greece. After all, things brought together in such confusion were the origin of collections; and in fact this custom was continued through the Middle Ages, changed only by the exclusion of objects not agreeing with the sanctity of the place. In a votive temple on the battle-field of Feuchtwangen hung the omoplate said to be that of the commander of the Teutonic Order who had fallen in battle four hundred years ago; it is now in the museum in Koenigsberg, Prussia, and belongs to a whale. Even now this custom is not entirely obsolete.

It seems certain that prominent naturalists, such as Aristotle and Apuleius, must have had collections, though there is no direct testimony to that effect given in any of their works still extant. The order of Alexander the Great for hunters, trappers, and fishermen to bring all kinds of natural objects to Aristotle, is well known; Theophrast and Apuleius are also known to have studied and dissected many different kinds of animals, chiefly fishes. Apuleius is the first naturalist known to have found it profitable and necessary to make voyages for the purpose of studying foreign animals, and collecting palæontological objects in the Getulic Alps, but unfortunately all his works on zoölogy are lost. The Emperor Augustus is considered the first prince possessing collections of a scientific nature.

I presume that the certain knowledge of the collections of the great naturalists above quoted was lost, as the collections themselves were quickly destroyed, for lack of means for sufficient preservation. The truth of this explanation is made more apparent since the successive discovery of more convenient and easier means of preservation of objects has made these collections more lasting and permanent through later generations. In a really interesting and obvious way, every new discovery, every improvement in the manner of preservation, has given a newer and stronger impulse to the enlargement of the collections, to the perfection of science.

Some methods of preserving objects were of course known to the ancients, but these methods were the same as those used for the preservation of food or of corpses, and generally not at all adapted or sufficient to preserve objects in a manner to make them fit for scientific purposes. The principal of these methods consisted in the exclusion or the prevention of the obnoxious action of oxygen. So the objects were preserved or dried, pickled with salt or spices, or entirely covered with salt water, honey, or wax.

The sow which was said to have borne thirty young pigs to Æneas was pickled by the priests, and was still to be seen at Lavinium in Varro's time, some ten centuries later. Large African animals pickled with salt, two hippocentauri and a large monkey, sent to Rome, were seen many years later by Pliny. Other large animals preserved in the same way were sent to the emperors in Constantinople, and even much later the hippopotamus described by Cohunna arrived, pickled with salt.

It was the custom among the Assyrian people to preserve corpses in honey, and this did very well also for delicate objects. When Alexander the Great conquered Suza, he found a very large and expensive quantity of purple dye two hundred years old, preserved in an excellent condition by an external layer of honey. Covering the objects with wax preserved them well, but for scientific purposes not better than the mummies of animals found to this day in the Egyptian pyramids. The celebrated book of Numa Pompilius, found in his grave, was entirely covered with wax, and, though five hundred years old, in perfect condition.

The long space of time after Christ's death, nearly twelve centuries, is entirely devoid of interest concerning natural history. Curious enough, and perhaps explaining this lack of interest, is the fact that in the earlier centuries of the Christian era the study of natural history was believed to be in some way a proof of religious infidelity. The reason of this will probably be found in the lack of education and study of the disciples and nearly all the apostles. Discussion would have been impossible, difficult, or of doubtful result. Simple faith covered all. So it happened that the prominent works of Aristotle were nearly lost in Europe. Translations of these into the Arabian language, introduced in the tenth century through Spain, and again translated into Latin, were used, and the original text was perhaps not known until the fifteenth century in the west of Europe. Except a few scanty pages in the works of Saint Isidorus, there was nothing written about natural history before the time of Albert the Great, and of course no collections existed. We are told by Begin, in his work on the natural history of the Middle Ages, that rich abbeys and cloisters possessed indeed some collections of medicinal or poisonous plants, of fossils, minerals, and shells. Even in the time of the Crusaders, such collections were augmented by frequent voyages in foreign countries. Some of these curiosities are still preserved: for instance, in the treasury of St. Denis, in France, the feet of a griffin, sent to Charles the Great by the Persian Shah; some teeth of the hippopotamus, and similar objects.

The vast erudition of the celebrated Albertus Magnus, a Catholic priest born in Bollstadt, in Germany, extended even to natural history. His works are in every way admirable. The manifold voyages of this savant, his long residence in very different places, Cologne, Paris, Rome, and Regensburg, facilitated the observation of different animals. The works of Aristotle were known to him only in the Arabian translation, and he apparently possessed no collection; at least, in going through his works, it is evident that the animals were described after living or fresh specimens.

Science, during the next three centuries, did not advance in a remarkable way; we find nothing but repetition of the statements of Albertus and his disciples, Cantipratanus, Bartholomæus Anglicus, Roger Bacon, Vincentius from Beauvais, and others.

The middle of the fifteenth century, and the time immediately following, is one of the most striking periods in history. The invention of printing, the discovery of America and of the way around Africa to the East Indies, the overwhelming amount of gold and silver gained by trade or war in those new countries and suddenly inundating all Europe, followed by the momentous times of the Reformation, made a change in fashion, in study, and in knowledge, never seen before, and perhaps never to be seen again. Art and science advanced in the same rapid manner, the latter prepared in some way by the large immigration of learned Greeks, after the destruction of the Greek empire by the Ottomans.

The same great time produced some discoveries of the highest importance to the existence and preservation of collections; the most important, now considered by millions as the greatest calamity, being that of alcohol. This fluid was known to alchymists long before, but the use of it as medicine, as drink, and for the preservation of animal substance, certainly not much before 1483. A poem printed in that year, in Augsburg, set forth the excellent qualities of the fluid, and stated decidedly that it had been proved that all meat, fish, and fowl put up in alcohol would be well preserved, and would never decay. But ten years later we find the same use and abuse of alcohol as at the present time. The use of alcohol for the preservation of objects offered the additional advantage of their being easily seen and studied. Something else was needed, however, namely, good transparent glass jars or bottles, and the means of closing them as well as possible. I have not been able to ascertain the time of the first manufacture of transparent glass bottles; I suspect, however, that it may belong to some earlier time. The use of cork to close bottles dates surely after the middle of the sixteenth century, as in 1550, at least in France, it was known to be used only for soles. Before this time, and even a century later, wax or resinous stoppers were used.

Paper, a very important object for collections, has been known since the beginning of culture in the East, but the use of it became gradually less and less, on account of heavy taxes upon it, from the beginning of the Christian era to the sixth century, and in the twelfth and thirteenth centuries the use of it was nearly forgotten. Cotton paper was carried by Arabs to North Africa in the tenth century, and two centuries later to Spain. Curiously enough the manufacture of linen paper was discovered through an intentional fraud. People first tried to make cheaper cotton paper by the introduction of linen rags, and very soon observed that the paper was greatly improved by this addition. Of course the manufacture with linen rags alone gave a more perfect paper, and was retained. This was probably first manufactured in Germany, as there exist old deeds in Bavaria on linen paper from the year 1318. Paper mills existed in 1341 in France, and later in Nurnberg, Holland, Basle, and Switzerland. Some mills existed in England, but produced only packing-paper; till 1690 all writing and printing paper was imported from Holland. It is sure that at the end of the fifteenth century linen paper was everywhere used, and cheap enough to displace the costly parchment. It is obvious that the common use of paper was a great advantage to every student. Botanical collections were only possible when the preservation of dried plants could be afforded. Just at this time the name herbarium, with its present meaning, seems to have originated.

Before this time, objects of natural history accompanied only by chance the more valuable objects of trade. Now science seemed suddenly to be awakened, or rather new-born. Every one was in haste to study the new objects, never seen before, and arriving in great numbers from newly-discovered countries. It was a natural consequence that those of the old country should be compared with the new ones, and every student was surprised to find so much around him that he had never known before.

Conrad Gesner, a naturalist from Switzerland, a student of vast erudition and clear judgment, may be considered the renovator of natural science. History begins a new volume with his name, and his works are for the next centuries of the same importance as those of Albertus Magnus for earlier times. Gesner began in a right and sensible way to study thoroughly the common objects nearest him, and by this means was enabled to understand more easily those from foreign lands with different features.

Switzerland, Genoa, Venice, Augsburg, Nurnberg, were at this time in a most favorable position for students. The largest trade of the world, from the East Indies, passing through these cities made them the most important centres of trade. The celebrated house of the Fuggers, in Augsburg, possessed the whole north of South America, a country larger than Europe; and it was therefore easy for them to collect in their princely mansions the wealth and curiosities of the world.

The desire to possess the largest collections increased in a way easily to be understood, especially as the invention of the printing-press had now afforded facilities for making the facts known to the world in a very short space of time. As the trade was in the hands of merchants, of course the collections were in their hands also, or in those of private students more or less widely known, as, for instance, Agrippa, Monardus, Paracelsus, Valerius Cordus, Hieronymus Cardanus, Matthiolus, Conrad Gesner, Agricola, Belon, Rondelet, Aldrovand, Thurneisser, Ortelius, from Italy, France, Switzerland, and Germany. England, too, was not behindhand, and Hackluyt gives an index of private collections in that country. The arrangement and contents of these collections are given in printed lists, the first known of which is that by Samuel Quickelberg, a learned physician of Amsterdam, published in 1565, in Munich. Shortly after, Conrad Gesner published the catalogue of the collection of Johann Kenntmann, a prominent physician in Torgau, Saxony. The whole collection contained in a cabinet with thirteen drawers, each with two partitions, about sixteen hundred objects: minerals, shells, and marine animals; and yet it was thought to be so rich that students made long journeys to see it, and Kenntmann stated that the objects were collected at such an expense as few persons would be able or willing to afford. Similar catalogues are published by Mercati, from Rome, Imperati, from Naples, Palissy, from Paris, and Thurneisser, from Berlin.

I cannot omit here to mention that nearly all interest shown in science was manifested by Protestants, the few honorable exceptions being mostly priests, who understood the times, and the necessity of being always among the foremost, in order not to lose their ascendency. The followers of Loyola were, soon after the institution of the order, eager enough to gain distinction even here. Following the history of our subject, our attention is called to the very striking fact that all departments of science before the Reformation fell gradually into the power of the predominant church, which hurled an anathema against all further investigations. The noble and brave inhabitants of Spain, the valiant and intelligent people of Italy, the nervous and quick-minded French, the accurate and slow Germans, all were in the same way subdued, and prepared to recognize nothing but the ideas approved by the church. Curiously enough, there never existed a stricter censorship of published books, the censors being at first Catholic priests and afterwards principally Jesuits, and their opinions are printed on the first page of many old works on natural history. It should never be forgotten that while those countries which accepted the Reformation grew stronger and stronger, fostered intelligence, and furthered science, all others, even the noblest, degenerated, and never again reached their former prominence, though they struggled bravely and nobly. Everybody will remember poor Galilei, a giant sacrificed to the glory of the church. Every kind of free thought seemed then, as at the present time, most pernicious to this infallible institution.

It now became the fashion for princes to possess collections. They contained celebrated medicines paid for by their weight in gold. Bezoar, the horn of the unicorn, the Maledivian nut, the Alraun, were perhaps placed side by side with such rarities as the pistol with which Berthold Schwarz tested gunpowder when he had discovered it, with Chinese or Egyptian relics, and what would now be considered bric-à-brac of every kind. The German Emperor Rudolf II., otherwise known for his avaricious and indecent behavior, spent large sums of money for his collections, and paid a thousand gold florins, a very large sum for those times, to his artist Hoefnagel, for drawing the specimens contained in them. The magnificent miniatures on parchment, in four volumes, are still extant. The Princes of Gottorf brought together an admirable collection, called, after the fashion of those times, Kunstkammer (cabinet of art), the remnants of which are still prominent treasures of the collections of Copenhagen and St. Petersburg.

A competition now arose between travelers in search of interesting objects. I will mention only those of the Baron von Herberstein to Moscow, of the Ambassador Busbeq to Constantinople, who imported the first tulip, of Olearius to the East Indies, and of Kaempfer to Japan. Eventually nearly every prince felt obliged to have a well-arranged cabinet.

A prominent physician in Nurnberg, Besler, published a description of his collection, or rather figures of some objects, in 1642; the first edition of which is very rare, printed on blue-tinted paper. The collection contains dried plants, Indian nuts arranged on a string (a horrid poison), a branch of a plum-tree with one hundred and twenty plums, weighing thirteen and one quarter pounds, horns of the unicorn, monstrous horns of other animals, a stuffed lynx, whose open mouth and red tongue made him look very ferocious, the cranium of a wolf, the bone of his tongue and wind-pipe, a rodent animal from Moscow, some birds, the cranium of a swan, a nautilus with carved shell, monstrous heads formed by shells, minerals, money, medals, crystals, the sword of Ziska, a Turkish pipe, vases of terra sigillata, fire-proof cloth of asbestos, jewels, guns, old stone hatchets, corals, Indian ink, fucus growing on a stone, and petrefactions.

I have enumerated purposely the contents of one collection of this time, and have chosen this particularly because it seemed to be the most interesting, as the description of it was reprinted four times in the years immediately following. A rich and partially classified catalogue of John Tradescant's collections was published in England by his son; but one will not be surprised to find such a heading: "Some kinds of birds and their eggs," and among them "Easter-eggs of the Patriarch of Jerusalem," and "the claw of the roc bird, which, as authors report, is able to truss an elephant."

As numerous other collections of this period were arranged in a similar manner, I prefer to mention only one more, that of the Jesuits in the Collegium Romanum at Rome, because the catalogue printed in 1678 shows the interior rooms in which the collection was arranged. As Italy was at this time still the leading country of the world in fashion and culture, and the order of the Jesuits influential and powerful, the arrangement of their collection may be considered as a fair example for others in that century, which certainly more or less imitated it, but never surpassed it. We find large, vaulted galleries, connected with vaulted rooms, the floor covered with inlaid marbles, the ceiling with allegorical pictures. The arrangement of the exhibited objects shows a kind of refined taste, and is agreeable to the eye; the taller and more prominent objects being arranged by themselves in the middle, as, for instance, a number of Egyptian obelisks, on the top of each of which were placed emblems of Christianity. Busts and other objects were placed on columns along the wall, the spaces between them being provided with shelves bearing smaller objects. Pictures and astronomical maps fill the upper part of the wall, and heavier things, such as a crocodile, are suspended from the ceiling. Not the least prominent object of the museum is an obelisk, made in the Egyptian fashion, to celebrate the memory of the conversion of the Swedish Queen Christina, the daughter of the most prominent king in the Thirty Years' War, Gustavus Adolphus, the fact of the conversion being expressed on the obelisk in thirty-three different languages.

Just at this time a curious historical essay on the origin and development of museums, and the best arrangement of them, was published, the author of which was probably a certain Major, and this very rare pamphlet, first published in 1674, has been reprinted later in Valentyn's Museum Museorum. According to the fashion of the time the author begins with the enumeration of the different names for such exhibitions, and out of forty of these, seventeen are Greek. I think it would be rather hard to remember them all, and even tedious to hear them repeated. The number of collections from the time of King Solomon to the author's time is computed to be one hundred and forty, twenty-two of which belonged to prominent princes; many of them are spoken of more in detail, but mixed with fabulous stories. The author believes it very probable that King Solomon possessed a collection, and is sure about King Hizkiah of Jerusalem, and Ptolomæus Philadelphus of Alexandria. He speaks about the museum of the Greek emperor in Constantinople, said to have contained the whole poetry of Homer written on the skin of a dragon, a fact which he concludes to be somewhat doubtful, as according to his calculation this skin must have been one hundred and twenty yards long.

At some length are given details about the collections of the Great Mogul in Agra, of the Inca in Peru, and of Montezuma in Mexico, the last two being real marvels of richness and value. All the animals, trees, and plants of the country were manufactured in pure gold or silver, in life size, and smaller ones in jewels, and placed in the gardens of the court. Montezuma is said to have possessed a zoölogical garden with all the living animals of the country, the ditches for marine animals being filled with salt water. Most of the facts given in this essay are partly exaggerated, partly erroneous; nevertheless some of the chapters, suggesting the best rules for arranging a museum, are quite interesting.

(To be concluded.)

CALIFORNIAN GARDEN BIRDS.

BY J. G. COOPER, M. D.

THE sociable and confiding disposition of the birds of the western United States as compared with the same species eastward has been noticed by several late writers, but the reasons have so far been scarcely mentioned. Among them perhaps the strongest is that bird-collectors and idle boys are less numerous, while sportsmen find larger game so plenty that they do not waste ammunition on birds so small that no one but a foreigner would take the trouble to pick them for the table.

Besides this, the prevalence of prairies over most of the western regions makes any garden full of trees and shrubs a rare nursery for the woodland species, where they find more protection from hawks and weasels than in their native groves, while they may also levy a small contribution on the fruits in return for the insects they destroy, and their lively songs. In California the poison intended for ground-squirrels has also destroyed millions of birds about the fields, and left them unhurt in gardens.

It is interesting to notice that most of the early travelers in California mention the comparative scarcity and silence of small birds about the first settlements..

In the garden at Haywood, eighteen miles southeast of San Francisco, in which I have before noted the nesting of the Anna humming-birds, so great a variety have built this spring that some notes on the others may be of general interest. The extent of ground is only half an acre around the house in which I live, and most of the nests mentioned are within it. The humming-bird referred to (*Calypte Anna*) is the only species that has built here, though swarms of the Nootka hummer frequented the eucalyptus-trees during April, on their way north. Another nest was built, and the eggs, laid April 23d and 24th, hatched May 11th, thus confirming the remarkably long (from seventeen to eighteen days) period of incubation.

A single *Stellula calliope* was shot April 16th near here. I saw one *Trochilus Alexandri* May 4th, and one *Calypte costæ* May 16th ; but these hummers are very rare near San Francisco. An Arkansas kingbird (*Tyrannus verticalis*) has a nest in a tree in the street adjoining the garden, but too high to examine. A black pewee (*Sayornis nigricans*) had built under the eaves of an adjoining barn as early as February, but also too high for close observation. A pair of western bluebirds (*Sialia Mexicana*) had raised a brood of young under the roof of the adjoining house, and all of them have frequented the garden much after May 4th. The well-known summer yellow-bird (*Dendrœca æstiva*) arrived April 20th, and a pair have a nest in the garden, though its site has not yet been discovered.

The barn swallow (*Hirundo horreorum*) builds, as elsewhere, in the barns, against rafters, etc., arriving March 19th. The cliff swallow (*Hirundo lunifrons*) builds under eaves of barns and houses much more abundantly than the last. I saw two instances in town where bluebirds took possession of nests of this bird about the 15th of March, and successfully held them against the owners, which returned from the south on the 24th. A pair of white-bellied swallows (*Hirundo bicolor* var. *vespertina* Cooper) took possession of a little bird-house which I put upon a post twelve feet high, near the house, and have built and laid eggs in it since April 30th. (Some others were building in town after their arrival three months earlier.) They had to drive off a saucy wren which had a nest near by, but had tried to hold two houses by building a sham nest in this one, and often endeavored to tear down the swallows' nest in their absence.

This western variety of the *H. bicolor* is larger and bluer than the eastern, though so far without a distinctive name. I found it breeding in 1873 as far south as latitude 35°, in Ventura County, Cal., near the coast. A house wren (*Troglodytes ædon* var. *Parkmanni*), as just remarked, built in a bird-house placed on the end of the porch. This species arrived March 30th, though a few winter within a hundred miles southward. The male of the pair mentioned came to the garden about the 10th of April, and very industriously worked at building a nest for two weeks before it persuaded a female bird to remain. It sung constantly, but less finely than the eastern birds, from which its longer tail, never held vertically, further distinguishes it.

Two pairs of the house linnet (*Carpodacus frontalis* var. *rhodocolpus*) have nests in a Monterey pine (*P. insignis*), another in a cypress, one under a plank placed in the forks of two trees for a swing to hang on, and one pair in a rose-bush covering the end of the porch, where children can look freely into it. This last had the first egg laid April 22d; incubation began on the 25th, and the young hatched May 6th and 7th, requiring about eleven days. Although thousands are shot in the fruit season on account of their destructiveness, neither the numbers nor the familiarity of this characteristic western bird seem to be diminished. They swarm also in the groves and kill vast numbers of the yet more destructive caterpillars during the spring months, being thus quite as useful as the imported English sparrows.

The Arkansas goldfinch (*Chrysomitris psaltria*), commonly called here "wild canary," abounds in gardens. A pair built in a rose-bush close to the path, and not over three feet from the ground, commencing to set on four eggs April 20th and hatching in ten days. They only raised one young, which left the nest May 16th. Others were fledged when this hatched, and still other pairs were just laying, in nests usually from six to twenty feet up in fruit-trees, one however in a pine. The eggs here are pale greenish or almost white, and 0.45 by 0.60 inch. The Lawrence's goldfinch (*Chrysomitris Lawrencii*), not yet distinguished by any popular name, is also abundant in oak groves, and has varied its habits so far as to begin to frequent gardens where coniferous trees grow, building in pines and cypresses, as the nearest approach in density of shade to the favorite live-oaks, though I have never seen these birds at Monterey, where the former trees are native. Dr. Brewer was evidently led into error by Dr. Canfield's identification of their eggs from Monterey, as given in North American Birds, i. 479, where he says they are "exactly similar to those of *C. psaltria*," etc. Those I got near San Diego in 1862 were, as described in the Ornithology of California, i. 171, "*pure white*, measuring 0.46 by 0.60 inch" (misprinted 0.80), and many found here are merely a little larger, 0.48 by 0.65 inch. A pair of chipping sparrows (*Spizella socialis*) built in a cypress about eight feet above the ground, and others have nests about the garden. They arrived March 31st, and the first egg seen was on May 14th. The gayest of the small summer visitors is the blue linnet (*Cyanospiza amœna*). It arrived April 20th and built a nest in the garden. A nest found in a thicket May 15th contained four nearly fresh eggs, like those described in the Ornithology of California. The brown finch (*Pipilo fuscus* var. *crissalis*), though often called "cañon finch," is not more common in secluded valleys than in gardens where protected; and, being a constant resident, becomes one of the tamest of native species, coming to the door for food and building as near the house as it can find a location. Like other resident birds it shows much variation in time of nesting, as it laid the first egg here as early as April 1st, in a pine-tree, twenty-five feet from the ground, and I suspect some were even fledged by that time, as was said to have occurred in a neighboring garden.

The western oriole (*Icterus Bullockii*) arrived here March 31st. My statement in the Ornithology of California that they arrive at San Diego as early as March 1st applies only to a very few *avant-courriers*, as most of them reach there after the 15th. They reached Ventura County in 1873 about the 20th; but as I saw one in the November previous, a few may winter in California, that being two months later than they usually leave.

A pair built in a hanging branch of a gum-tree (*Eucalyptus*) in the garden, about thirty-five feet from the ground. The male was in the immature plumage (like the female), and another male skinned by me April 24th was similar, so that, like *Icterus spurius*, some of the males, if not all, require more than one year to obtain perfection, a fact not before recorded. Like the *Icterus Baltimore* and the other species as far as known, it probably requires three years, though the stages are not so very different as to have been called *species*, as with *Icterus spurius* and many tropical American forms.

The following birds also built in other gardens in town, but I could not watch them so carefully. The western yellow-bellied fly-catcher (*Empidonax difficilis*) arrived March 30th. One pair built early in May on a beam under a wagon-shed, in the manner of the pewees, but, pertinaciously retaining their woodland habits, tried to conceal the nest by a wall of green moss partly hanging over the edge of the beam and making it still more conspicuous by the contrast of color. Three other nests found along the neighboring creeks were built on slight projections among roots and stumps overhanging the water, from four to twenty feet above it, and all with the same green mossy parapets. I have identified the birds by shooting several. The differences in both young and adult birds between this and the eastern *E. flaviventris* pointed out in the North American Birds, iii. 363, as well as the entire difference in nesting and eggs described on page 380, with which mine agree perfectly, seem to require a specific separation of the western birds, none being found intermediate. In the Ornithology of California, i. 328, I could not distinguish the western adult bird from the incomplete descriptions of the eastern, the young only having then been critically compared.

The *Empidonax pusillus* of Northern California seems, however, to graduate southward into the eastern var. *Traillii* as given by me, though I should have used the prior specific name. The nests and eggs described by me in the Ornithology of California, i. 330, probably belonged to *pusillus*, which I have not seen in this more open region. *E. Hammondii* is a more eastern form.

Swainson's greenlets (*Vireosylvia gilvus* var. *Swainsonii*) arrive about March 30th, and some keep about gardens, where I have found their old nests. None of the characters distinguishing the western and eastern races seem to be invariable, while their songs and habits do not serve to distinguish them specifically. Their arrival at San Diego, April 10, 1862, as published by me, must have been two weeks later than usual.

The western mocking-wren (*Thryothorus Bewickii* var. *spilurus*) is a constant resident, but commonest in winter. A pair built in a small box in a stable, and had young when discovered in April. The open nest in a bush described by me in the Ornithology of California, i. 69, is evidence of an unusual departure from their common habits, and was very probably an old nest built by some other bird, this species generally building in dark cavities of trees, brush-heaps, etc., but now apparently growing more familiar. It shows variations in building similar to *T. Ludovicianus.*

The American goldfinch (*Chrysomitris tristis*) is less common here in summer than the western species, immense numbers going north of this State in April, while the others are not known to occur in Oregon, and most of *C. Lawrencii* go south of this latitude in winter, being then replaced in numbers by this species. On this coast they seem to breed earlier than eastward, as I found several undoubted nests in Ventura County about April 18th, in willows where none of the other species ever appeared. The eggs described by me from Santa Cruz may, however, have been those of *C. Lawrencii*, as they were smaller than usual, perhaps, however, from belonging to a second brood.

I may note here, in connection with this genus of birds, that I killed one of *C. pinus* as late as April 15th, and that they built in the tall pines near Monterey, where I saw them in June, 1874. This most southern locality recorded is accounted for by the cool winds, fogs, and pines of the place.

The California song sparrow (*Melospiza melodia* vars. *Samuelis*, *Heermanni*), like all species of birds which run into many local varieties, is little if at all migratory. Where cats are not too troublesome it becomes the most familiar of birds. The great variations in the size of these birds in California, from which the varieties above named and also *M. Gouldii* have been described (and even placed in other genera), are not confined to any latitude, unless the last (and smallest) was from the peninsula, the middle-sized (*Samuelis*) being found about San Francisco Bay, though more rare than larger ones. In Ventura County I found them to vary in full from 5.65 to 6.25 long, wing 2.40 to 1.80. The eggs also vary exceedingly in size and pattern between the extremes given in Birds of North America, iii. 25 and 27.

I might extend this catalogue of garden birds considerably by mentioning additional species found building in other places in gardens, but less commonly. The following are common here along creeks on the borders of the town, but not yet found building within garden fences.

The Oregon thrush (*Turdus ustulatus*), now known to build as far south as latitude 35° and probably 34° in California, arrived here April 20th, when *T. nanus* had gone north. I have been informed that the robin (*T. migratorius*), never before known to remain in the valleys in this latitude in summer, has begun to breed in cherry orchards three miles from here.

The black-capped warbler (*Myiodioctes pusillus* var. *pileolatus*) arrived March 30, and in Ventura County March 18, 1873. This is a month earlier than I saw them nearer the coast, as noted in the Ornithology of California, i., and accounts for their early appearance in Oregon. It is a month earlier than the summer yellow-bird, for which I mistook it in 1854 at Puget's Sound, arriving April 10th. (Natural History of Washington Territory, ii. 181. These dates also need correction in later books.)

The bank swallows (*Cotyle serripennis*) have holes in the steep banks of the creek, one of which I opened May 17th, and found seven fresh eggs in it at a depth of two feet, and five feet from the top of the bank. The ground wren (*Chamæa fasciata*) is a resident in bushy places along creeks or on dry hills, and often frequents fences about clearings where shrubs or brush are abundant. It is very artful in concealing its nest in dense thickets. The plain titmouse (*Lophophanes inornatus*) is a very sociable bird where its favorite live-oaks are left standing near houses, building in March in any suitable hole it finds. The least titmouse (*Psaltriparus minimus*) is another sylvan bird which remains about houses among oaks and other trees, even in the city of San Francisco. I obtained a nest with seven fresh eggs on May 15th. The western purple finch (*Carpodacus purpureus* var. *Californicus*), though not before seen in summer in the valleys, sometimes remains near the cool bay of San Francisco, and, if not building in gardens, joins the house linnets in their depredations on fruit.

The black-headed grosbeak (*Hedymeles melanocephalus*), a delightful summer songster often called here "bullfinch," is inclined to be very sociable, though its nests are so often robbed by boys for cage-birds that it builds mostly in places more retired than gardens.

The redwing blackbird (*Agelaius phœniceus*, and var. *gubernator*), though preferring marshes, often builds here in small trees on the borders of boggy streams within cultivated grounds, if unmolested. I saw a fine male this spring with the shoulders entirely orange, the opposite extreme from var. *gubernator*. Brewer's blackbird (*Scolecophagus cyanocephalus*) is numerous about houses, and builds in companies in low trees where unmolested. It has recently taken to roosting in winter in the evergreens of the "Plaza" in the noisiest centre of San Francisco, with English sparrows. The California jay (*Cyanocitta Californica*), if not so much persecuted, would be abundant and very bold around houses where oak-trees grow, but the boys drive them to wilder building-resorts. Its thievish habits and practice of destroying other birds' eggs make it a bad tenant. The size of eggs I gave in the Ornithology of California was misprinted 1.80 by 1.04 instead of 0.80 by 1.04; these San Diego eggs being, as usual, smaller than others from northward.

Gairdner's woodpecker (*Picus pubescens* var. *Gairdneri*) is a common visitor to the gardens, and, like its eastern relative, will doubtless burrow for nests in old fruit-trees. The allied *Picus Nuttallii* seems to avoid this region.

The rufous humming-bird (*Selasphorus rufus*), though very familiar in other places at least as far south as latitude 35°, I have not seen here building near houses, though a few do build along creeks, preferring moist locations. On the other hand, the barn owl (*Strix flammea* var. *pratincola*) is very common, and, where protected for the purpose of destroying vermin, becomes familiar. One pair has a nest in a windmill, and another built in a hole in a steep, high bluff at the edge of a garden, where I got fresh eggs April 10th. The nest and eggs mentioned as from me in North American Birds, iii. 522, prove to belong to the *Geococcyx*.

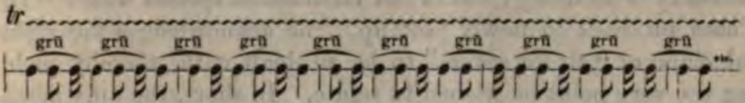
Finally, the California quail (*Lophortyx Californicus*), though becoming rare so near San Francisco, is very tame about houses where it is protected, feeding and laying eggs near the barnyards.

THE CHIRP OF THE MOLE-CRICKET.

BY SAMUEL H. SCUDDER.

THE common mole-cricket of the United States (*Gryllotalpa borealis* Burm.) usually commences its daily chirp at about four o'clock in the afternoon, but stridulates most actively at about dusk. On a cloudy day, however, it may be heard as early as two or three o'clock; this recognition of the weather is rather remarkable in a burrowing insect, and the more so since it does not appear to come to the surface to stridulate, but remains in its burrow usually an inch below the surface of the ground. The European mole-cricket is said to chirp both within its burrow and at its mouth (*plerumque sub terrâ*, Fischer says), and it may be that our species sometimes seeks the air in chanting; but the chirp, as far as I have heard it, always has a uniformly subdued tone, as if produced in some hidden recess. Fischer says that the European species, which is twice as large as ours, cannot be heard more than from one hundred to one hundred and fifty feet (*ultra spatium* 20–30 *passuum*). Ours, when certainly beneath the surface, is easily distinguished at a distance of five rods; and one would presume that it could be heard, if above ground, nearly twice as far away.

Its chirp is a guttural sort of sound, like *grü* or *grēēu*, repeated in a trill indefinitely, but seldom for more than two or three minutes, and often for a less time. It is pitched at two octaves above middle C, and the notes are usually repeated at the rate of about one hundred and thirty or one hundred and thirty-five per minute; sometimes, when many are singing, even as rapidly as one hundred and fifty per minute. Often, when it first commences to chirp, it gives a single prolonged trill of more slowly repeated notes, when the composite character of the chirp is much more readily detected; and afterward is quiet for a long while. When most actively chirping, however, the commencement of a strain is less vigorous than its full swell, and the notes are then repeated at the rate of about one hundred and twenty per minute; it speedily gains its normal velocity. The note sounds exceedingly like the distant croak of toads (*Bufo*) at spawning season, but is somewhat feebler. Zetterstedt com-



pares the chirp of the European species to the note of *Hyla arborea.*

Although belonging to the saltatorial Orthoptera, this insect, like the other species of its genus, is a poor leaper; *inepte salit*, says Fischer of its European congener. But on the other hand, it can run backward quite as easily as forward, — a fortunate gift, as the greater part of its burrow is too narrow for it to turn in. — *Psyche*, Cambridge, Mass.

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REPLY TO MR. J. A. ALLEN'S "AVAILABILITY OF CERTAIN BARTRAMIAN NAMES IN ORNITHOLOGY."[1]

BY DR. ELLIOTT COUES, U. S. A.

MY reply to Mr. Allen must not be considered controversial, for two reasons. In the first place, my original article stated the whole case, from my point of view, so carefully, so completely, and so explicitly, that I am left without ground for further argument. Secondly, nothing that Mr. Allen adduces in his critique invalidates the principle I established, most of his criticism being irrelevant to the main point at issue, namely, that if any of Bartram's identifiable, described, and binomially named species were entitled to recognition, then all such of his were equally so entitled. Mr. Allen himself admits this, the whole point and purpose of my article, his protest being simply against the painful necessity of so doing; out of ten Bartramian species which "Dr. Coues proceeds to newly 'set up,'" he acknowledges the rightful claim of "six or seven" to be so dealt with, thereby yielding the very point he wished to refute. In short, the only actual disagreement between Mr. Allen and myself is that he is able to identify satisfactorily rather fewer of Bartram's species than I succeeded in doing. But this last is a matter to which I gently alluded in my article when I said in substance that ornithological experts would of course identify Bartram's species according to their respective ability.

But Mr. Allen's article is so courteous, so temperate, and written with such evident intention and desire to be perfectly just to all concerned, and yet misses the mark so widely, that I feel called upon to examine it further; in doing which, I trust I may not fall behind my critic in the amenities; surely I hope not to. No serious disagreement can long subsist when each feels and shows the respect due to the other, and when neither is contending for himself, but for the truth and the general good.

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[1] An article in The American Naturalist for January, 1876, x. 21–29, criticising my article "Fasti Ornithologiæ redivivi, No. 1," in Proc. Acad. Nat. Sci. Philadelphia, September, 1875, pp. 338–358.

Before proceeding further, I will dispose of the only point on which Mr. Allen has misrepresented me; let me hasten to add that I am sure he did so unintentionally. For he says that I advocate the adoption of certain names "whether they are accompanied by descriptions or not." But he did not really consider me guilty of such folly; what he meant was, whether accompanied by sufficient, formal descriptions, according to the usual interpretation of what constitutes a description. For reasons set forth at length in my paper, I hold that all of Bartram's species were in effect described. How inadequate many of his descriptions were is seen in the large number of unidentifiable species. Of course I admit this; but the *quality* of Bartram's descriptions is not a point at issue.

Next, I wish to bring prominently forward a strong and good point Mr. Allen makes, namely, that species, to be tenable, must be identifiable by something in the work itself in which they are named; it not being allowable to use knowledge subsequently gained to identify them upon a principle of exclusion, or any other process of cumulative circumstantial evidence. This is the gist of the sound count that my friend makes against me; for I certainly applied some of the knowledge which is the common property of ornithologists of 1875 to the identification of species proposed in 1791; and if this kind of reasoning, and the sort of "moral" certainty reached by its means, be ruled out as evidence, I should not wonder if, of the ten species I newly set up, no more than the six or seven Mr. Allen admits would be allowed to stand. I willingly concede the point, but, in paying my respects to Mr. Allen on this score, would simply ask him, What has this to do with the proposition of mine, that if any of Bartram's species are tenable, then all his fully identified, described, and binomially named ones are too?

The rest of Mr. Allen's critique may be summed under several heads, as follows: —

(1.) The general statement that Bartram was a pretty poor sort of an ornithologist after all. As an expression of his opinion, Mr. Allen has a perfect right to say so, and I should be the last to restrict the freedom of his judgment; but it is irrelevant to the case at issue. I think rather more highly of our author than Mr. Allen seems to, and in fact I wish we had no worse ornitholgists to deal with, though there have been such before and since Bartram's time; but I never made his general standing as an ornithologist an argument in favor of adopting certain of his names. Yet this wholly uncalled-for attempt to depreciate Bartram's general ability as an ornithologist occupies much of Mr. Allen's space.

2. Regarding our author as a binomialist: Those who are sufficiently interested may compare Mr. Allen's paper with mine in [illegible] to find that we agree exactly, though Mr. Allen has had recourse to the arithmetic of the case, which I did not consider necessary. If the figures should show that Bartram lapsed from binomial propriety every other time, instead of about once in every seven times, the circumstance would absolve no one who uses *Corvus carnivorus*, for instance, from using *Corvus frugivorus* too. This is, in substance, all I ever claimed.

3. Mr. Allen accuses Bartram, by implication, of giving correct names "when he happened to know them," otherwise of preferring to coin names as the easiest way out of a difficulty, not having the means of ready identification, or not caring to take the trouble required for determination. Now, in the first place, this is a gratuitous assumption that Bartram did not do the best he knew how, and, as such, surely indefensible from any standpoint. Secondly, supposing Bartram was a fraud, and did "gobble" all the species he could, what has that to do with the question? The fact that he did coin names simply imposes upon us the necessity of recognizing such of them as are binomial, are identifiable by descriptions accompanying, and possess priority. His motives are no longer subjects of public inquiry. If all the species which early and late ornithologists have "borrowed" and printed as their own were canceled, what a relief it would be to the synonymical lists!

4. Mr. Allen inquires, with some warmth, whether this sort of thing "tends to the best interest of science." It may or may not, I know, but I believe it does, and that time will show it does. At any rate, the reason Mr. Allen adduces for his belief that it does not is not a sound one. He says, "If the example Dr. Coues is here setting be followed, there will be no stability in our nomenclature for a long time, but only, except perhaps to a few experts, the most perplexing confusion." But I contend that the only possible road to stable nomenclature is that which leads to the very bottom of the matter. In the nature of the case, the process of striking "bed-rock" is desultory, uncertain,

and confusing; I admit, as I deplore, the inconvenience and the difficulty. But a fact is no less a fact because it is a disagreeable one; and whether we like it or not, the fact remains that names of species will continue to shift until the oldest one that is tenable according to rule is recognized. Therefore the sooner a species is "hunted down," the better; and this is just what I undertook to do in the cases of a few of Bartram's. I did it partly on the score of "justice" to that author, but this was not my main object. I am no sentimentalist in such matters, and if I thought it would be to the best interest of science to ignore Bartram, I should quietly do so. It is simply because I believe it best, in spite of transient inconvenience, to bring him to light, that I have done so, in an attempt to secure that very stability which Mr. Allen accuses me of disturbing. To speak my mind freely, I may add that I should have been disappointed, considering that I had signally failed, had not my paper made some disturbance; exactly that effect was anticipated and fully intended, otherwise the paper would not have shown *raison d'être.* And I am encouraged further to believe that the paper tŏok its own step, however short, in the right direction, by the recollection that certain *Fasti* of my honored predecessor in this particular line of work, whose title I have had the presumption to revive, were received with wry faces and shrugs — and received, nevertheless. I am perfectly satisfied to let my own be tested in the crucible of time.

(5.) The remainder of Mr. Allen's paper is chiefly devoted to the examination, *seriatim*, of the individual cases in which I claim priority for Bartram. This portion of his paper is a fair and strong counter-argument to mine. It requires, however, no comment from me, since all this part of the subject, in which the general principle is not involved, is only left where I put it, in the hands of the experts, each of whom will determine for himself which particular ones of Bartram's names he can identify to his satisfaction, and which he cannot. Without here scrutinizing the cases in which I believe Mr. Allen to be wrong, I wish to acknowledge one instance in which he shows that I am probably wrong — the case of *Certhia pinus*, No. 10, which I now see is probably, as Mr. Allen says, *Helminthophaga pinus*, not *Dendrœca pinus*, as I too hastily assumed.

Finally, let me say a word respecting Mr. Allen's suggestion taht I ought to have gone further, and attributed to Bartram the priority of discovery of the great law of geographical variation in size, which recent naturalists have developed and formulated. I suspect that Mr. Allen allowed himself to become slightly quizzical at the close of his critique; but I shall take him at his word, and reply seriously. I do not find that Bartram presents anything but a statement of fact of the smaller size of Floridan animals as compared with those from Pennsylvania; to do which, nothing but a tape-line, or, failing that useful article, a good pair of eyes and fair memory, were requisite. Whereas, in treating of the same important subject himself, Mr. Allen has been prominent among those who have generalized from the facts to broad conclusions; and in so doing has displayed inherent powers of mind which, coupled with extensive and varied acquirements, have won for him the high position he now holds among American naturalists.

RECENT LITERATURE.

Powell's Exploration of the Colorado.[1] — The first part of this volume contains the personal narrative by Major Powell of his perilous and successful exploration of the most wonderful river-gorge in the world. The second part, containing his observations on the physical features of the Valley of the Colorado, will be noticed in a future number of this journal.

The narrative is one of the most thrilling records of personal adventure we have ever read; the interest of the reader is intense from the first to the last page, the story being told in a modest, unpretending way, so that the dangers do not seem exaggerated, and the impression produced by the rare exhibition of courage and endurance is not lessened by any straining for effect in the words of the narrator.

The cañon of the Colorado is over a thousand miles long, and at one point over a mile (6200 feet) in depth. This deep cut is broken at intervals by lateral cañons, where branches, such as the Grand, Yampa, Virgin, Kanab, and others, enter the main stream. An idea of the grandeur of these dark, solitary gorges, with vertical sides often nearly a mile high, and with pinnacles and towers overhanging the river winding like a silvery thread below, may be gained by a glance at the figures of Mukoon-tu-weap Cañon, of a cañon in Escalante Basin (Fig. 5.), but especially of the Grand Cañon. The bird's-eye view of the Terrace Cañons (Fig. 6) represents the relations of these cañons to the surrounding country.

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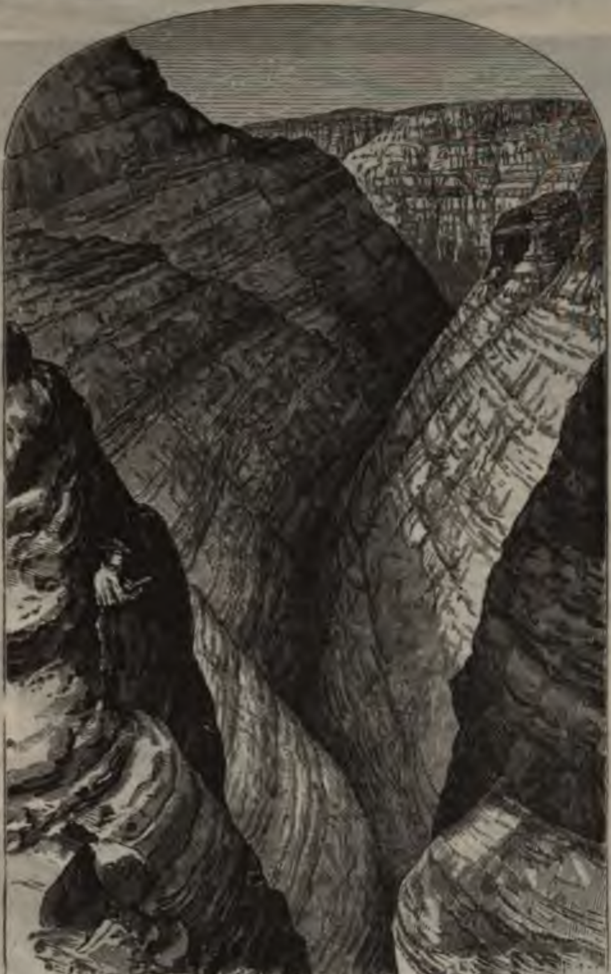
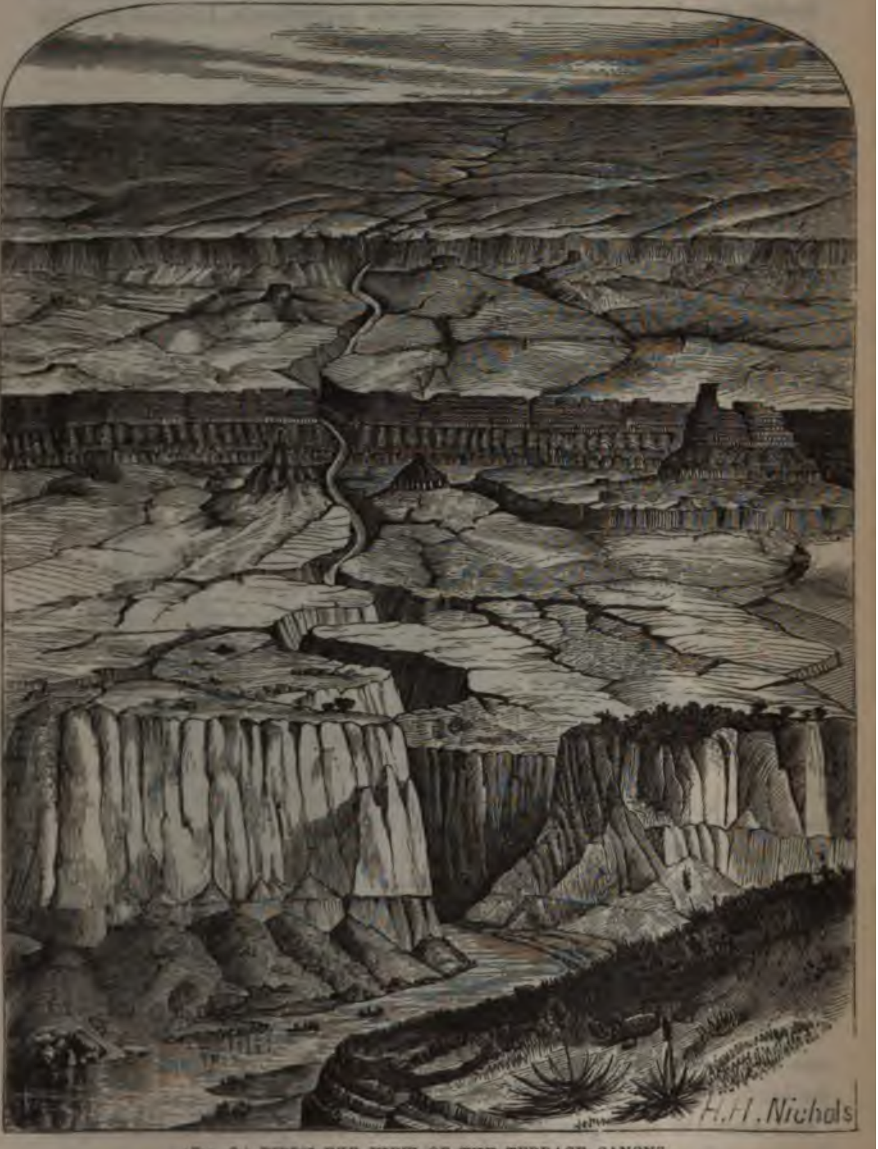
[1] *Exploration of the Colorado River of the West and its Tributaries.* Explored in 1869, 1870, 1871, and 1872, under the Direction of the Secretary of the Smithsonian Institution. By J. W. Powell. Washington, D. C. 4to, pp. 291. With Maps and Illustrations.

On the 24th of May, 1869, the expedition, in three boats, left Green River Station on the Union Pacific Railroad, and after floating down the river, shooting rapids, letting their boats down over falls, often upsetting, losing one boat and many provisions and instruments, haunted day after day with the sense of worse dangers ahead than those already overcome, and near the close, just as they had escaped the greatest peril of all, left apparently to their fate by three of the party, who escaped the dangers of the cañon only to be murdered by the Indians, they emerged on the 29th of August from the Grand Cañon of the Colorado, and the next day reached the Mormon settlements at the mouth of the Virgin River.


H.H.NICHOLS, SC.

(FIG. 5.) CANON IN ESCALANTE BASIN.

Near the Grand Cañon Mr. Powell met some of the Shi-vwits, a tribe of Ute Indians, more primitive than any other Indians seen on this continent by our author. They subsist on wild fruits, nuts, and native grains.



(FIG. 6.) BIRD'S-EYE VIEW OF THE TERRACE CANONS.

The *oose*, or fruit of the yucca or Spanish bayonet, which is rich, not unlike the paw-paw, they eat raw and roasted. "They gather the fruits of a cactus plant, which is rich and luscious, and eat them as grapes, or from them express the juice, making the dry pulp into cakes, and saving them for winter; the wine they drink about their camp-fires, until the midnight is merry with their revelries.

"They gather the seeds of many plants, as sunflowers, golden-rods, and grasses. For this purpose they have large conical baskets which hold two or more bushels. The women carry them on their backs, suspended from their foreheads by broad straps, and with a smaller one in the left hand, and a willow-woven fan in the right, they walk among the grasses and sweep the seed into the smaller basket, which is emptied, now and then, into the larger, until it is full of seeds and chaff; then they winnow out the chaff, and roast the seeds. They roast these curiously: they put the seeds with a quantity of red-hot coals into a willow tray, and, by rapidly and dexterously shaking and tossing them, keep the coals aglow, and the seed tray from burning. As if by magic, so skilled are the crones in this work, they roll the seeds to one side of the tray as they are roasted, and the coals to the other. Then they grind the seeds into a fine flour, and make it into cakes and mush."

A chapter follows containing A Report on a Trip to the Mouth of the Dirty Devil River, by A. H. Thompson, which is succeeded by the second part, On the Physical Features of the Valley of the Colorado, while the third part is zoölogical in its nature, containing treatises by Dr. Coues and Mr. Goode.

COPE'S CHECK-LIST OF NORTH AMERICAN BATRACHIANS AND REPTILES.[1] — This is the first of a new series of works published by the Department of the Interior for the United States National Museum, under the direction of the Smithsonian Institution. Besides the check-list which will prove useful to students, Professor Cope enters into an elaborate discussion of the geographical distribution of the vertebrates, particularly the batrachians and reptiles, of the northern hemisphere. The author divides the earth's fauna into six realms, those of the northern hemisphere being the realm of the new world (Nearctic) and that of the old world (Palearctic). However well these terms (first proposed, we believe, by Dr. Sclater) may apply to the vertebrates, when we come to the insects and marine invertebrates the terms "Nearctic" and "Palearctic," as applied to the circumpolar region, seem to us to be somewhat artificial, though applying well to the north temperate hemisphere. The essay, however, will be found exceedingly useful and timely.

KIDDER'S NATURAL HISTORY OF KERGUELEN ISLAND.[2] — The second Bulletin of the United States National Museum contains the notes on the birds of Kerguelen Island made by Dr. Kidder while attached as naturelation to the American Transit of Venus Expedition in 1874–75. The studies are of much interest, as the climatic features of the island are peculiar, while there are no land birds or mammals, strictly speaking, indigenous to it, and but a single shore-bird (*Chionis minor*), though the island is about ninety miles long and fifty broad, with snow-covered mountains, the highest of which (Mount Ross) rises to an elevation of about 5000 feet. The birds observed were pelagic forms, such as gulls, albatross, penguins, etc. The species have been determined by Dr. Coues, whose synonymical and other notes give additional value to the essay.

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[1] *Check-List of North American Batrachia and Reptilia.* By EDWARD D. COPE. Bulletin of the United States National Museum. I. Washington, D. C. 1875. 8vo, pp. 104.

[2] *Contributions to the Natural History of Kerguelen Island.* By J. H. KIDDER, M. D. Bulletin of the United States National Museum. II. Washington, D. C. 1875. 8vo, pp. 51.

THE *ZOÖLOGICAL* RECORD.[1] — Though it is nearly time for the appearance of the volume for 1874, it is perhaps not entirely too late for us to call the attention of our readers to the value of these yearly indexes to the literature of systematic zoölogy. They deserve an extended circulation in this country, where access to zoölogical works is limited, and students away from large libraries are obliged to use such a record. Possessing such a manual of recent zoölogical literature, and ascertaining what has been published in his special department, the isolated student can borrow from central libraries works of which he otherwise would be totally ignorant.

We notice that the last four volumes are much thinner than the early ones. Is this a sign of the zoölogical millenium when all the new species and genera shall have been described, and students will be forced to study the anatomy, physiology, and development of animals?

SCUDDER'S FOSSIL BUTTERFLIES.[2] — This beautifully printed and illustrated memoir is the result of a critical and extensive examination of the specimens of fossil butterflies existing in European museums, none having yet occurred in this country. After describing the fossils with minuteness, and elaborately comparing them with related forms now living, the author discusses the comparative age of fossil butterflies, the probable food-plants of tertiary caterpillars, and the present distribution of butterflies most nearly allied to the fossil species, besides noticing such insects as have been erroneously referred in recent times to butterflies.

It appears that nine well-authenticated species of butterflies are now known, all from the European Eocene and Miocene tertiary formations, and that they represent all the families of butterflies except the *Rurales*, represented by the *Lycænæ*. Of the allies of the nine fossils forms, four now live in the East Indies, three in America, on the confines of the tropical and north temperate zones, one in the north temperate zone of Europe, Asia, and America, and one on the shores of the Mediterranean.

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[1] *The Zoölogical Record* for 1872. Edited by ALFRED NEWTON. 8vo, pp. 495. The same for 1873. Edited by E. C. RYE. London: John Van Voorst. 1875. 8vo. pp 543.

[2] *Fossil Butterflies.* By SAMUEL H. SCUDDER. Memoirs of the American Association for the Advancement of Science. I. Salem, Mass. 1875. 4to, with 3 steel plates; pp. 99. $1.00. For sale by the Naturalist's Agency, Salem, Mass.

Three out of the four species whose living allies occur in the East Indies come from the older deposits of Aix, and only one of the two remaining Aix species shows special affinities to American types. "We thus find here," the author remarks, "as among other insects and among the plants, a growing likeness to American types as we pass upward through the European tertiaries."

This handsome memoir appears in print through the generosity of Mrs. Elizabeth Thompson, of New York city, who generously gave the sum of one thousand dollars for the promotion and publication of original investigations by members of the association. The results in every way prove the wisdom of the donation, and we express the hope that similar benefactions may follow from other sources.

SACHS'S HISTORY OF BOTANY.[1] — Under the patronage of the King of Bavaria, the Royal Academy of Sciences is publishing a History of Modern Science in Germany. The treatment of the individual sciences has been entrusted, by a special commission, to men eminent in their respective departments. This volume is one of the earliest of the series. Professor Sachs, of Würzburg, well known as a high authority in vegetable physiology, and more widely as the author of A Text-Book of Botany, was selected to write the history of botany. The history is given in three books. The first treats of morphology and systematic botany, and covers the period from Otto Brunfels (1530) and Fuchs (1542), down to 1860. The most interesting chapters are those devoted to morphology as influenced (1) by the theory of metamorphosis and the spiral distribution of leaves (1790–1850), and (2) by a fuller knowledge of the cell and the lower grades of plants, and (3) by the theory of development (1840–1860). Professor Sachs looks upon the work done during the twenty years just mentioned, as having freed morphology and systematic botany from their old prejudices; sight has become clearer, the methods of investigation safer, and the manner of putting questions sharper.

The second book sketches the progress of vegetable anatomy from Malpighi and Grew (1671–1682) down to the time of Nägeli. The author justly regards Von Mohl and Nägeli as having together placed this division of botany on a secure foundation. The molecular theory of the latter is considered the basis of modern vegetable physiology.

To this subject the third book is devoted. The conflicting views which have been held respecting reproduction, nutrition, and the dynamics of plants are fully presented and with great fairness. It is hardly possible to detect any partiality in this remarkable section. It remains to be noticed that this history is not confined to botany in Germany; Germans may, however, well be proud of the large and honorable share which their countrymen are here shown to have taken in the advancement of the science, and they may congratulate themselves upon the selection of an historian who has not ignored the claims of other nations.

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[1] *Geschichte der Botanik vom* 16 *Jahrhundert bis* 1860. Von DR. JULIUS SACHS. München. 1875. (A History of Botany from the 16th Century to 1860. By DR. JULIUS SACHS. Munich. 1875.)

THE OCTOPUS.[1] — This is a pleasant account of the Octopus or poulpe, adapted to the mind of the average visitor at the immense aquarial establishments of the sea-ports of England, and perhaps worth reading on this side of the water, where poulpes — "these blasphemies of creation against itself," as Victor Hugo styles them — are common enough southward, but fashionable colossal aquaria are as yet lacking.

EDWARDS'S BUTTERFLIES OF NORTH AMERICA.[2] — The fourth part of the current series of this magnificent work, issued from the Riverside Press at the end of December last (but dated November), contains fewer subjects than usual. two whole plates being given to illustrate the history of *Melitæa Phaeton* and *Papilio brevicauda.* The former plate is perfect as far as the colored figures are concerned, and cannot be surpassed, if it can be equaled, by the best of foreign work ; but the plain lithograph of the web is not so satisfactory, showing in but few places any indication of the web-like structure. The other plates contain three species of *Argynnis* (*A. Eurynome*, *Bischoffi*, and *Opis*), and two of *Grapta* (*G. Hylas* and *Marsyas*). The text accompanying the three plates given to these insects is mainly descriptive, but contains some strictures on Mr. Scudder's classification of these species of *Grapta.* The accounts of *Phaeton* and *brevicauda*, on the other hand, are very full, and are welcome additions to the history of our butterflies. That of the former is very nearly complete, but contains a few errors ; for instance, in the statement that the rows of hair-bearing tubercles of the newly hatched caterpillar "indicate the position of the future spines." It has long since been pointed out (*Canadian Entomologist*, March, 1872) that this is not the case, the position of few or none of the spine-bearing eminences of the mature caterpillar corresponding with those of the previous hair-supporting tubercles. These are points of structure to which the author pays little attention, but which are very important in their bearing upon the affinities of butterflies.

In writing that "*Phaeton* alone, out of a hundred species of butterflies that frequent our fields," protects itself in the larval stage "in a web woven by the community," Mr. Edwards seems to be unaware that this is the case with every one of the tribe to which *Phaeton* belongs, as far as their history is known, and will therefore doubtless prove true of the few species of Eastern North America whose history has not yet been fully elucidated. It is also true of some other of our common butterflies.

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[1] *The Octopus, or the Devil Fish of Fiction and of Fact.* By HENRY LEE. With Illustrations. London. 1875. 12mo, pp. 114. For sale by the Naturalist's Agency, Salem.

[2] *The Butterflies of North America.* With Colored Drawings and Descriptions. By WM. H. EDWARDS. Boston : H. O. Houghton & Co. 4to. $2.50.

The food-plant, *Viburnum dentatum*, given on the authority of Mr. Glover (doubtless borrowed from Dr. Packard) is probably a mistake. The caterpillar of *Phaeton* has been found upon a great variety of plants, such as Aster, Corylus, Berberis, Solidago, Vernonia, Clematis, and Rubus, and even upon ferns, grasses, and flags; but this is to be accounted for simply by the roving disposition of the caterpillar.

It is strange that Mr. Edwards makes no allusion whatever to the very careful account of the history of this insect given three or four years ago by Mr. Lintner.

Recent Books and Pamphlets. — The Native Races of the Pacific States of North America. By Hubert Howe Bancroft. Vol. V. Primitive History. New York: D. Appleton & Co. 1876.

Birds of Western and Northwestern Mexico, based upon Collections made by Colonel A. J. Grayson, Captain J. Xanthus, and Frederick Bischoff. By George N. Lawrence. (Memoirs of the Boston Society of Natural History.) 4to, pp. 54.

Zoölogical Results of the Hassler Expedition. II. Ophiuridæ and Astrophytidæ, including those dredged by the late Dr. William Stimpson. By Theodore Lyman. With five Plates and five Figures printed in the Text. (Illustrated Catalogue of the Museum of Comparative Zoölogy, No. 8.) 4to, pp. 34.

Neomenia, a new Genus of Invertebrate Animals described by Tycho Tullberg. With two Plates. (Proceedings of the Royal Swedish Academy of Sciences, May 12, 1875.) 8vo, pp. 12.

On the Osteology and Peculiarities of the Tasmanians, a Race of Man recently become extinct. By J. B. Davis. (From the Transactions of the Dutch Society of Sciences, of Haarlem.) 1874 4to, pp. 20. Two Plates.

Geological Notes. I. On the Newport Conglomerate. II. On the Gravel and Cobble-Stone Deposits of Virginia and the Middle States. (From the Proceedings of the Boston Society of Natural History.) Boston. 1875. 8vo, pp. 13.

Remarks on Canker-Worms and Description of a new Genus of Phalænidæ. By Charles V. Riley. (From the Transactions of the St. Louis Academy of Sciences.) 8vo, pp. 15. St. Louis. November 5, 1875.

Notes on the Natural History of the Grape Phylloxera (*P. vastatrix* Planchon). By Charles V. Riley. 8vo, pp. 7.

Ueber die Umwandlung des Mexicanischen Axolobt in ein Amblystoma. (Siebold und Kölliker's Zeitschrift, xxv.) 8vo, pp. 37. 1875.

Rectification of the Geological Map of Michigan, embracing Observations on the Drift of the State. By Alexander Winchell. Salem. 8vo, pp. 26.

Botanical Bulletin. Vol. I., No. 1. November, 1875. John M. Coulter, editor, Hanover, Ind. $1.00 a year. Monthly.

An Illustration of North American Agrotis and Oncocnemis. By Leon F. Harvey. With a photographic plate. 8vo, pp. 4. Buffalo, N. Y. 1876.

On Noctuidæ from the Pacific Coast of North America. By A. R. Grote. With a photographic plate. 8vo, pp. 10. Buffalo, N. Y. 1876.

The Spiders of the United States. By N. M. Hentz. (Occasional Papers of the Boston Society of Natural History, II.) With 21 plates. 8vo, pp. 171. Boston. 1875. Paper, $3.00; cloth, $3.50.

Pisciculture. An Address on the Artificial Breeding of Fish, their Habits, etc., delivered before the Detroit Scientific Association. By N. W. Clark. Detroit. 1875. 8vo, pp. 20.

Bulletin of the United States Geological and Geographical Survey of the Territories. No. 5, second series. 8vo, pp. 233–414. Washington, D. C. January 8, 1876.

GENERAL NOTES.

BOTANY.[1]

Exotic Plants around San Francisco Bay. — Many of the species of the Australian eucalypti and acacias mature their seeds in the climate of the shores and neighborhood of San Francisco Bay; many of the foreign geraniums and fuchsias also seed and fruit in the open air, though exposed more or less to the trade-winds; this is notably the case at the university grounds at Berkeley, which are in a line due east from the Golden Gate. — R. E. C. Stearns.

Preissia commutata. — In a communication to the editor, Mr. Henry Gillman reports *Preissia commutata* (liverwort) at Laughing Fish River, and Eagle River, Michigan, at White-Fish Bay, Wisconsin, and several other localities on the Lakes. The plant occurs chiefly on sandstone.

Sequoia sempervirens. — The statement on page 571 of the Naturalist for 1875, of the discovery of a grove of colossal redwood trees, *Sequoia sempervirens*, proves to have been a hoax.

Very large specimens of this species are occasionally met with in the forests of the Coast Range. Six miles east of Stewart's Point and twenty-three miles west of Healdsburg, in Sonoma County, a fine specimen may be seen on the farm of James McCappin; it is not far from three hundred feet in height, and reaches up about one hundred feet to the first limb; it is quite straight and symmetrical, and measures seventy-one feet four inches in circumference at one foot from the ground; seven feet higher the circumference is forty-six feet. — R. E. C. Stearns.

Æstivation of the Fuchsia. — "In the books," the petals of the fuchsia are described as convolute. At my request, one of my students examined one hundred and fifty-nine flowers of various species, hybrids, and varieties. The petals exhibited sixteen different modes of arrangement with reference to each other. Only twenty-eight, about one sixth, were regularly convolute; of these, twenty-one twisted to the right, and seven to the left. Seventy-five flowers, nearly half of all examined, had one petal outside at each edge, the others in regular order. In thirty-seven cases, one petal was entirely outside, the one opposite to it had both edges covered by those next to it.

The foregoing remarks are kindred to those on Phyllotaxis of Cones, in the Naturalist, vii. 449, and on Imbricative Æstivation, viii. 705. — W. J. Beal.

Vallisneria spiralis. — This plant, growing in moderately deep water in the south of Europe, has long been a favorite object of cultivation in aquaria, from the clearness with which the rotation of the protoplasm can be made out in the cells of the leaves, and the remarkable phenomena connected with its mode of fertilization, though the latter is less often witnessed, owing to the comparative rarity of the male plant. At a recent meeting of the Linnæan Society, of London, Mr. A. W. Bennett read a paper on the phenomena connected with the development of the peduncle of the female flower. This attains a final length of from three to four feet, and the rapidity of its growth is perhaps unequaled in the vegetable kingdom, being at its most rapid period at the rate of twelve inches in twenty-four hours. By marking off and measuring from time to time equal portions of the peduncle as they developed above the surface of the water, Mr. Bennett determined that the greatest activity of growth is displayed by the terminal portion of the flower-bud. A marked length of 2 inches from the flower-bud increased to 6.5 inches during the time that the remainder of the peduncle increased from 8.7 to 21.25 inches, showing a greater energy in the former case in the proportion of three to two. This presents a greater analogy to what is known to be the ratio of development of different parts in the case of roots than in the case of aerial stems, in which the zone of greatest activity of growth is generally at some considerable distance from the apex. Very few observations have, however, been made on the relative rate of growth of different portions of the same internode. When unfertilized, the peduncle of the female flower does not coil up and withdraw the flower below the surface, as is the case when pollen from a male flower has had access to it, but floats in a wavy manner on the surface; and under these circumstances the female flowers remain open for days and even weeks, as if waiting for the male flowers. — A. W. Bennett.

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[1] Conducted by Prof. G. L. Goodale.

Insectivorous Plants. — An interesting series of experiments confirmatory of the power stated by Darwin to be possessed by the leaves of *Drosera*, of absorbing nourishment through their glands, has been made by Dr. Lawson Tait, of Birmingham, England. He placed side by side plants of the common *D. rotundifolia*, some in the normal state, others with the roots pinched off close to the rosette of leaves, and with the leaves all buried, only the budding flower-stalk appearing above the sand; others with the roots and flower-stalk left on, but all the leaves pinched off, the roots being buried in the sand; and others again with the roots left on but appearing above the sand, some of the leaves buried and others exposed. These plants were all carefully washed with distilled water before being planted in silver sand which had been deprived of all organic matter, and carefully watched to prevent flies being caught; they were then fed, some with pure distilled water, others with a strong decoction of beef, and others with a very dilute solution of phosphate of ammonia. The conclusions arrived at from the series of experiments were that the plant can not only absorb nutriment by its leaves, but that it can actually live by their aid alone, and that it thrives better when supplied with nitrogenous material in small quantity. The nitrogenous matter is more readily absorbed by the leaves than by the roots, overfeeding killing the plant sooner through the leaves than through the roots alone, although the roots also certainly absorb nitrogenous matter. Dr. Tait had announced, independently of Mr. Darwin, the separation of a substance closely resembling pepsin from the viscid secretion of the glands of *Drosera dichotoma.*

In the September number of the (London) *Journal of Botany,* Mr. J. W. Clark details another important independent series of experiments with a similar result. He obtained large quantities of plants of *Drosera rotundifolia,* and a smaller quantity of *Pinguicula lusitanica,* and fed the leaves with the bodies of freshly-killed flies soaked in a solution of citrate of lithium. The needful precautions being taken to prevent the solution from being carried mechanically to other parts of the plant, after an interval of forty-five or fifty hours various portions of the plant were incinerated, and the ashes tested for lithium by the spectroscope. The result proved conclusively that the products of digestion, after absorption by the leaves, do enter the leaf-stalk, and are thence distributed to other parts of the plant. — A. W. BENNETT.

THE LIFE-HISTORY OF MOULDS. — A most important contribution to our knowledge of the lower forms of life is contained in Dr. Oscar Brefeld's Botanische Untersuchungen über Schimmelpilze (translated by Dr. W. R. McNab in the *Quarterly Journal of Microscopical Science* for October), containing an account of a series of very close observations on the life-history of *Penicillium glaucum* and others of the commonest moulds belonging to the same genus. Besides the well-known non-sexual mode of reproduction by conidia, Dr. Brefeld detected also on the mycelium bodies which he terms "sclerotia," the products of a sexual process. These contain the germ of a second generation produced from the fertilized carpogonium. There are therefore in *Penicillium* two stages or alternations of generations. The first or sexual generation is large, and capable of producing non-sexual spores. The second or non-sexual generation is small, and lives as a parasite on the nutrient tissue which surrounds it in the form of a sclerotium or sporocarp, which after a time develops asci and ascospores, these latter again producing the first sexual generation. This formation of ascospores seems to show that *Penicillium* must be placed in the group of Ascomycetes; and Brefeld considers that, from the striking resemblance of the minute structure of the sclerotia of *Penicillium* to that of the common truffle, this genus of moulds must be placed close to the Tuberaceæ. — A. W. BENNETT.

FUNGI HEAPED UP IN PINES BY SQUIRRELS. — Mr. J. S. Fay has sent us specimens of a fungus which he finds heaped up in considerable quantities in the crotches of young pine-trees not more than ten or twelve feet high, at Wood's Hole, Mass. Mr. Fay at first supposed that these heaps were accidental, but is now convinced that they were made either by squirrels or blue jays. The fungi are *Boleti,* and, as far as can be determined from their present condition, all of one species. There are several species of *Boletus* found at Wood's Hole, but they all grow on the ground. The most probable supposition is that the heaps were made by squirrels, and it would be interesting to know whether they actually eat the fungi. Perhaps some reader of the NATURALIST may be able to settle this point. — W. G. FARLOW.

MESSRS. H. O. HOUGHTON & Co., of the Riverside Press, design publishing shortly a series of sketches of the wild flowers of North America, from studies by the well-known botanical artist, Mr. Isaac Sprague. Those who are familiar with the accurate work of this skillful artist, particularly with his recent illustrations in Mr. Emerson's Trees and Shrubs of Massachusetts, will welcome the promised plates. Each portfolio of four colored plates is to be accompanied by descriptive letter-press, in which the more interesting details of structure and the habits of the plants will be explained.

BOTANICAL PAPERS IN RECENT PERIODICALS. — *Bulletin of the Torrey Botanical Club*, New York, December, 1875. *Epiphegus Virginiana* var. Rauana. (A description, by Mr. Austin, of an unusual form of beech-drops. The variation is believed by the editor to be due to feeble development.) *Omphalaria pulvinata* Nyl., a lichen new to North America, has been found at Poughkeepsie by Mr. W. R. Gerard.

Botanical Bulletin, December, 1875. Professor Porter gives a short list of double wild flowers. Several notes of local interest.

Comptes rendus des Séances de l'Académie des Sciences, lxxxi. 19. On exhaustion of the soil by apple-trees, by Is. Pierre. 20. On the theory of carpels, by Trécul. (A study of the pistil in one of the Amaryllis family.) 21. On fibres of remarkable length and tenacity, by Is. Pierre (from *Lavatera*, of the Mallow family). On fixation of atmospheric nitrogen in soils, by Truchot. On the formation, structure, and breaking-down of the swellings in the grape-vine produced by *Phylloxera*, by Cornu. On production of sugar in the beet-root, as affected by loss of foliage, by Cl. Bernard. Villiane, Duchartre, Boussingault, and Pasteur have notes on the same subject. On hydrated cellulose, by Girard. 24. On the destruction of vegetable substances mixed with wood, by Barral and Salvesat.

Flora, 1875, No. 27. Dr. Luerssen continues his description of the vascular Cryptogamia collected by Dr. Wawra in the Sandwich Islands. No. 28. Description of some lichens new to Europe, by W. Nylander.

Botanische Zeitung, November 12, 1875. Reports of societies: The association at *Graz:* Kirchner gave some account of the botanical works of Theophrastus, especially the volume on Vegetable Physiology. This was described as being marked by fullness of detail, and indicating acuteness in investigation. An annotated German translation is now promised. Von Ettingshausen gave reasons for believing that *Castanea* *vesca* is descended from *Castanea atavia.* No. 47. On the marine Phanerogams of the Indian Ocean and Archipelago, by Naumann. (An account of the flowering plants found in salt water during the cruise of the Gazelle.) Nos. 48, 49. Contributions to the history of the development of the Sporogonium in liverworts, by Kienitz-Gerloff. In reports of societies: *Berlin:* Ascheron on the distribution of the sexes of *Stratiotes,* a plant allied to *Sagittaria.* (The pistillate and staminate plants are for the most part widely separated.) Nos. 50, 51. On the development of cambium, by Dr. Velten. (Examining N. J. C. Müller's views.) In reports of societies: *Brandenburg:* Braun on the morphological nature of the tendrils in the gourd family (regarding them as leaves, and in divided tendrils each division as one leaf). *Berlin:* Brefeld on conjugating fungi.

Sitzungsberichte der kaiserlichen Akademie der Wissenschaften, lxx. i. Contributions to the morphology and biology of yeast, by Emil Schumacher, of Lucerne (detailing experiments to determine the influence of low temperature, etc., upon the life of the yeast plant). Lxx. ii. Investigations respecting the occurrence of lignin in the tissues of plants, by A. Burgerstein. (Experiments with aniline sulphate, by which he determined the absence of lignin in fungæ and algæ. It is found in a very few plant-hairs, in all wood-cells, but never in cambium. Many bast-cells have considerable lignin, but the sieve-cells hardly any. The most curious observation was that the walls of pith-cells in many plants are lignified, and the medullary rays also.

ZOÖLOGY.

Breeding Range of the Snow-Bird. — During a flying visit paid to the mountains of Southwestern Virginia, the latter part of June, I found *Junco hyemalis* very common on the summits, at an altitude of forty-five hundred feet. A nest containing three eggs, about to hatch, was discovered within a stone's throw of the house. It was built on the ground, in a hole in a slight embankment. The mother-bird fluttered in sight within a few feet of me, of course rendering the identification absolute; besides, the birds were plentiful in the vicinity, and well known to the most obtuse of the aborigines of this primeval region. The southern extension of the species during the breeding season has only lately become known. Professor Cope mentions it in a former paper in the Naturalist, and I have no doubt that he is right in crediting the species with a breeding range to the mountains of Georgia. This circumstance of its distribution explains the sudden appearances and disappearances of the species, according to the weather, during the colder portions of the year, at low levels. It can readily change its summer for its winter abode, and conversely, by a few hours' flight.

While on this subject, let me allude to the slip of the pen, or momentary aberration of mind, I don't know which, that led me to give the

"Graylock range" as an instance of the southward dispersion of this bird in the breeding season, at page 141 of the Birds of the Northwest. The proper allusion is to some mountains in North Carolina. — E. C.

HOMOLOGIES OF MAMMALIAN TEETH. — Professor Cope has recently investigated the homologies of the different types of mammalian teeth. He refers all of them to four types, the haplodont, ptychodont, bunodont, and lophodont. The first is a simple cone or truncate cylinder in form, and from it all the others are derived by folding vertically (ptychodont) or transversely. The lophodont teeth are the most complex, and consist of various modifications of the bunodont type. The bunodont tooth has the summit of the crown composed of obtuse tubercles, which may be high or low or flattened in different ways. The odd-toed hoofed mammals have the outer tubercles flattened so as to have a crescentic or V-shaped section, and the inner tubercles are either simply conic or connected with the outer by cross-crests of various character. The rhinoceros, tapir, Symborodon, etc., possess such teeth. The ruminating animals, on the other hand, have both the inner and outer crests much flattened, so as to be crescent-shaped in section, and they are also much elevated, so as to leave deep valleys between them, which are often filled up with cement.

The flesh teeth of the lower jaw of carnivora were shown to be derived from a simple tubercular (bunodont) tooth with four cusps, by a process of change which is to be chiefly observed among Eocene carnivora. Professor Cope finds that some of these add a small fifth tubercle, and that this is connected with the outer front one of the four by a low ledge. Successively the two hinder tubercles disappear, and the front or fifth grows larger. The ridge connecting the latter with the outer grows longer and higher, and the inner front then disappears. Finally the hinder part of the tooth disappears also, leaving but two apices connected by a cutting edge, which is characteristic of the flesh-tooth of the lion and tiger.

The human molar tooth is one of the simpler forms of the bunodont division.

PROTECTIVE RESEMBLANCE IN THE YELLOW-BIRD. — On passing an embankment of the Grand Trunk Railway at Fort Gratiot, Michigan, one warm day in August, 1872, we noticed that numbers of the yellow-bird (*Chrysomitris tristis* Bon.) had collected where an extensive growth of the common mullein (*Verbascum thapsus* L.) lined the slope. Each bird had perched on the apex of a spike of the blossoms, the color of which was almost the identical shade of yellow in the plumage of the bird. The mulleins were ranged in stiff files, like soldiers in yellow uniforms, and each bird, as we passed, remained motionless, looking like a continuation of the spike, of which one might be easily deceived into thinking it part and parcel. As soon as we had passed by, the birds were again busy, flitting from plant to plant, feeding on the seeds, and enjoying themselves.

We could not avoid thinking that there was a meaning in the action here described, significant of an established protective habit, especially considering the decided changes of plumage assumed by this species at different seasons of the year. — HENRY GILLMAN.

SHELLS OF KERGUELEN ISLAND. — The naturalists connected with the Transit of Venus Expedition have begun to make their reports.

In the report of Dr. J. H. Kidder, of the Kerguelen station, now in press, Mr. W. H. Dall contributes a list of the mollusca collected, describing three new genera. One of these was described in a late number of the *Annals and Mag. Nat. Hist.* by Mr. E. A. Smith, of the British Museum, under the name *Eatonia*, long since preoccupied by Hall for a genus of brachiopoda. For this Mr. Dall substitutes *Eatoniella*. Mr. Dall also describes a genus allied to *Ceropsis* of the *Carditidæ*, but smooth and without lateral teeth, and with a semi-internal ligament, giving it the name *Kidderia*, in honor of the naturalist of the expedition. Dr. P. P. Carpenter also describes a new genus of chitons, with the anterior and posterior valves marginate, but not slit, and the other valves without a margin. This genus, intermediate between *Hanleia* and the articulate chitons, he calls *Hemiarthrum*.

ANTHROPOLOGY.

JASPER WAR-CLUB TEETH. — In the sixth volume of the NATURALIST, page 157, fig. 24, I described a large flint implement as a hatchet. Such specimens I have since been led to consider as teeth, if I may so call them, of war-clubs; the handles of which were frequently the femora of the elk and bison. This form may be briefly described as obtusely pointed, short, and broad jasper implements; evenly chipped to a well-defined edge. Average-sized specimens measure about three to four inches in length, by two and a half to three in breadth. While the chipping is not as fine as in arrow and spear points, it is certain that the majority, at least, are finished implements, as suggested by the author of Flint Chips (p. 439), and not merely "blocked out" masses of jasper, to be subsequently worked into spear-heads and similar forms (see Rau on Agricultural Implements, Smithsonian Annual Report, 1868, p. 401). Besides these finished specimens, I have found that the larger flint implements, which I have considered to be either "lance-heads" (Proc. Acad. Nat. Sci. of Philadelphia, 1860, p. 278) or agricultural implements when blunt and broad, and weapons when narrower and pointed, in vol. vi. of this journal, page 155, fig. 22, — that these, when broken in half, were subsequently utilized as I have suggested, just as broken arrow-heads were occasionally made available, by conversion into scrapers (see this journal, vii. 500), except that in the latter instance the base of the broken implement was used, and in the former, the pointed or upper half. My reason for considering them as the teeth of war-clubs is that the point, although blunt, is well defined, and the edges equally so, and that the implement as made was intended for penetration rather than cutting, but necessarily by the aid of a handle, inasmuch as the base has a roughly chipped edge, which would prevent its being used effectively if simply held in the hand. Certainly as a simple cutting implement or hatchet it would not have been pointed. This supposed use of these specimens, as described, is confirmed by the discovery lately of three specimens of such implements in Indian graves. Each of these chipped flints had evidently been inserted into long bones (femora) of some large mammal. The bones themselves had so nearly decayed that only minute fragments could be gathered, but the outline was distinguishable as the relic lay in the ground. Two of these specimens of flint teeth had evidently been wrought *de novo* from the mineral; the other was as evidently the pointed half of a lance-head, or hoe, the base being a single surface, showing that the specimen had there been broken directly in two. Somewhat confirmatory also of this view of the use of such relics is the fact that of the broken specimens of "lance-heads" found lying on the surface of the ground, the vast majority are the bases; the points having been gathered and utilized, I believe, in the manner suggested. War-clubs of wood, armed with a metal tooth, are now seen among the Indians. Catlin, in his North American Indians, vol. ii., plate 150, figures such an one, and frequently refers to them throughout that work. Prior to the introduction of metals, war-clubs were of course common, but armed with stone instead of iron. The jasper implements above described, I doubt not, were the forerunners of the metal teeth of the modern club. — CHARLES C. ABBOTT, M. D.

OPENING OF A ROYAL BURIAL MOUND IN DENMARK. — The Royal Society of Northern Antiquaries at Copenhagen has recently published a beautifully illustrated folio volume containing a description of a royal burial mound or barrow, with translations of the Runic inscriptions on stones, at Jellinge, of the time of the royal pair, Gorm and Thyra.

GEOLOGY AND PALÆONTOLOGY.

THE EARLIEST EDENTATES (SLOTHS). — The earliest sloths hitherto known have occurred in the Miocene Tertiary. Professor Gaudry has recently announced to the French Academy traces of the existence of edentate mammals at the beginning of the Miocene epoch. The remains consist of a first phalanx and an ungueal phalanx, which seem to come from the same finger. He places this new animal in the genus *Ancylotherium*, with the specific name of *priscus*. The fossils have been found in the same bed, suggesting that the edentate in question has lived at the time of the lower Miocene as well as at the last phase of the Eocene.

A FOSSIL SIRENIAN ANIMAL IN JAMAICA. — The former existence, in Jamaica of an animal of this group, rather smaller than the manatee is indicated by the skull and atlas vertebra, described by Professor Owen under the name of *Prorastomus sirenoides* in the *Quarterly Journal of the Geological Society of London.*

GEOLOGY OF NEW CALEDONIA. — In an article on the metallic mines of New Caledonia, by Rev. W. B. Clarke, besides a notice of the mines of chromic iron and nickel, there is given, in *La Revue Scientifique*, a *résumé* of the geology of these islands.

GEOGRAPHY AND EXPLORATION.

UNITED STATES COAST AND INTEROCEANIC SURVEYS. — The late annual report of Commodore Ammen, Chief of Bureau of Navigation, states that the work of geographically determining as many points as are supposed necessary, in Central America and in the West Indies, was prosecuted last year by the United States steamer Fortune, and this year by the Gettysburg. The longitude of Panama, Aspinwall, Santiago de Cuba, and Havana have been determined by means of the telegraph. The work now in course of completion will include points on the Windward Islands and the northern coast of South America. The survey of the outer coast of the Peninsula of Lower California, and that of the Gulf of California, had been concluded by Commander George Dewey, commanding the Narragansett. The gulf was previously unsurveyed, but has now been sufficiently examined and determined for the safety of navigation. Commander A. J. Mahan, commanding the Wasp, has made much-needed surveys at the mouth of the Rio de la Plata.

It is recommended that when a vessel can be spared for the purpose from those employed on the North Pacific Station, a running survey be made of the coast of Gautemala. This would render the surveys (of different values) continuous from Behring's Straits to Cape Horn. Since completing the lines of deep-sea soundings in the Pacific Ocean for cable purposes, another line has been run by the United States steamer Tuscarora, under the command of Commander Herber, from San Francisco to the Sandwich Islands, and some soundings were also made on the return of the said vessel from the Navigator Islands to Honolulu.

In regard to interoceanic surveys, this work, which has been carefully prosecuted for five seasons by two or more parties from the Isthmus of Tehuantepec to twenty or more miles south of the mouth of the Napipi, on the River Atrato, is at length satisfactorily accomplished. Since the last report a careful survey of the Isthmus of Panama has been made, the computations completed, and the whole placed before the Interoceanic Canal Commission.

THE TUNDRAS OF SIBERIA. — The prevalent idea that the plains of Siberia are frozen the year around is dispelled by Nordenskiöld in his account of his Siberian journey, to be found in *Nature*. "We were yet far north of the Arctic Circle, and as many imagine that the region we had now passed through, the so little known tundra of Siberia, is a desert waste, either covered by ice and snow or by an exceedingly scanty moss vegetation, it is perhaps the place here to declare that this by no means is the case. On the contrary, we saw, during our passage up the Jenisei, snow only at one place, a deep valley cleft of some fathoms' extent, and the vegetation, especially on the islands which are overflowed during the spring floods, was remarkable for a luxuriance to which I had seldom before seen anything corresponding.

"The fertility of the soil and the immeasurable extent of the meadow land, and the richness of the grass upon it, had already called forth from one of our hunters, a middle-aged man, who is owner of a little patch of land between the fells in Northern Norway, a cry of envy of the splendid land our Lord had given 'the Russian,' and of astonishment that no creature pastured, no scythe mowed the grass. Daily and hourly we heard the same cry repeated, though in yet louder tone, when we some weeks later came to the lofty old forests between Jeniseisk and Turuchansk, or to the nearly uninhabited plains on the other side of Krasnojarsk, covered with deep *tschornosem* (black earth), in fertility certainly comparable to the best parts of Scania, in extent exceeding the whole of the Scandinavian peninsula. This direct expression of opinion by a veritable if unlearned agriculturist may perhaps not be without interest in judging of the future of Siberia."

THE SWEDISH EXPEDITION TO NOVAYA ZEMLYA. — In our last number we gave some account of Nordenskiöld's expedition. His ship, the Pröven, which he placed under the command of Dr. Kjellman, has returned to Norway. *Nature* reports that the party found an abundance of marine vegetation in the Kara Sea, which has been hitherto thought to be remarkably destitute of vegetable life. "We have," the letter to the Stockholm daily paper concludes, "during this summer sailed over known and unknown seas more than six thousand (English) miles; we have visited regions whither expeditions for more than three hundred years have attempted in vain to come; we have made rich collections in all departments of natural science." Nordenskiöld, who is the distinguished professor at the Royal Swedish Academy of Stockholm, reached St. Petersburg on the 17th of November, having journeyed overland from the mouth of the Jenisei River. An account of his journey appears in *Nature* for December 2d.

THE KYBALE RACE. — An exhaustive monograph of this people (La Kybalie et les Coutumes Kabyles), in three large octavo volumes, by MM. A. Hanoteau and A. Letourneau, has been noticed in successive numbers of the *Revue Scientifique*. These Kybales are the descendants of the ancient Numidians, and their country forms a part of Algeria.

PICTURES OF YÜNNAN. — Under this title F. Garnier has published a work on this inland province of China, abstracts of which, with fine views of the striking scenery of the country and the people, are appearing in *Globus*, a weekly German journal of travel.

MEXICAN MIGRATIONS. — At the Exposition International de Géographie held at Paris last year, Professor Quatrefages exhibited an unpublished map illustrating the migrations of the Mexicans.

MICROSCOPY.[1]

AMATEUR MICROSCOPES. — The notorious success of Mr. Wenham, the late Mr. John Williams, and some other microscopists, in preparing their own apparatus, is exceptional only by reason of the degree of excellence attained. It is especially true of microscopists that they love the instruments they work with, and from this love follows not only the partially unfortunate "test-object fever," but also the eminently useful habit of studying, adapting, altering, and finally manufacturing accessories, if not instruments, suited to their needs and fancies. Such amateur work not only is the best possible drill in the science of the microscope, but also has added very largely to the development of the microscope of to-day. The European journals are full of interesting and profitable results from such work; while the readers of the NATURALIST have long been familiar with the contrivances and original constructions of a considerable number of American workers. Most microscopists, however, have confined their attempts to the production of accessories, believing, very judiciously, that the microscope as a whole could be more successfully made by more experienced hands. Of the comparatively few home-made microscopes, two recently published forms may serve as examples of the two extremes of ultra simplicity on the one hand and the best attained success on the other. In the form contrived by Mr. John Phin and described in his Practical Hints, the body consists of a tube of stiff writing-paper rolled several times around itself, pasted at the outer edge, and blackened on the inside. This tube slides, for focal adjustment, through another paper tube. A piece of looking-glass serves as mirror, and a demolished cigar box furnishes wood enough to make the remainder of the stand. A simple half-inch lens acts as objective, and a similar lens of two-inch focus constitutes the ocular or eyepiece. The lenses are held in place in the tube by means of the bottoms of pill boxes perforated to allow the passage of light, while similarly perforated pill boxes are placed in the tube in proper position to act as diaphragms to reduce aberration by cutting off stray light. Such a microscope, at a cost of fifty cents, is conceded to be too imperfect to use for scientific study or even for instructive amusement, its utility being not in the using but in the making of it. It is believed that a student by actually constructing such an instrument would gain a very clear idea of the essential parts of the microscope, as well as a good understanding of the faults of simple work and uncorrected lenses.

The more elaborate instrument referred to is described by Mr. John

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[1] This department is conducted by DR. R. H. WARD, Troy, N. Y.

Michels in the last November number of the *Popular Science Monthly*. The essential parts of a microscope-stand are simplified and combined with great ingenuity and judgment. The form of stand is essentially that of the pocket microscopes of Swift and some other London makers, in which a single inclined bar, resting on the table at its lower end and supported by two legs near its upper end, carries firmly and conveniently the mirror, stage, and compound body. The blackened paper tube which serves as body is large enough to receive a good ocular or eyepiece at the top, and contains at the bottom a society-screw adapted to hold any objectives that may be chosen. It slides through a wooden tube lined with cloth, giving a good coarse adjustment. This wooden tube is glued, by means of an intervening piece of wood, to the main inclined bar of the stand. The stage is of wood, or gutta-percha modeled into shape while warm, also attached by means of a block of wood, and the object slide is held in position by elastic india-rubber bands. The mirror and its immediate mounting is that of a common student's stand. This instrument stands nearly fifteen inches high when in use, weighs one pound, and can be packed within a space fourteen by three and a half by three inches. It is perhaps the best amateur microscope that can be made at the present time by a student of average mechanical skill. One reason why it is the best is because it contemplates the use for all its optical parts of first-class professional work; for we cannot quite agree with its author that there is no reason why the student should not make his own lenses. Objectives have reached a degree of excellence which has quite outgrown the skill of an ordinary amateur. True, Mr. Wenham can make lenses of surpassing excellence, and so could Mr. Spencer, while still unlearned in the science and unpracticed in the art of microscopy, but such instances are so rare as not to compromise the accuracy of the statement that amateurs cannot make as good lenses as they can buy. Nor do we think that the author does full justice to the recent progress achieved (though still too little) by the regular makers in the way of furnishing good and useful work at an available price. What is called first-class apparatus is still prohibitively costly, and much of the cheap work is more than correspondingly poor; yet instruments can now be bought at a reasonable cost that would not be fairly described as characterized by "diminutive size, smallness of field, poor light, shortness of tube, absence of society's screw, and other evils" which "will soon cause" them "to be cast aside." Nor do we share the author's difficulty in finding lenses in this country which he can specially recommend. Most of our distinguished makers now prepare not only lenses of excessively high angle and price, but also lenses of exquisite workmanship, moderate angle, simple mounting, and available price; lenses which we recommend with double pleasure because of our strong faith in the utility of moderate angles for general use, and our firm belief that the perhaps necessarily high cost of the high-angle lenses has materially retarded the growing popularity and usefulness of the microscope itself.

A Remarkable Forage for Bees. — Rev. J. L. Zabriskie, whose interesting papers on bee-bread, in the *Bee Keepers' Magazine*, have given readers unfamiliar with the sciences concerned a reliable understanding of the structure of pollen, and the curious development, upon the hind legs of the bees, of the pollen brushes and pollen baskets with which the pollen is gathered, loaded up, and carried to the hives, observed, during the last summer, bees coming to his hives loaded with an unusually large quantity of a pollen-like powder having a bright vermilion color, not before noticed. The pollen baskets were filled to overflowing with this novel food, which the bees were carrying to their hives and storing away in the usual manner. Microscopically examined the grains were unlike any known pollen, but corresponded exactly in their peculiar color, size, shape, granular contents, and character and delicate markings of the epispore, with the raspberry rust, which was abundant at the time on leaves in the garden and adjoining fields; this rust being a leaf fungus (*Uredo luminata*) whose delicate mycelial cells force themselves among and draw nourishment from the cells which form the tissue of the leaf, and which at the time of fruiting rupture the skin in little spots on the under surface of the leaf, and develop crowded clusters of bright red spores surrounded by the upturned edge of the ruptured leaf skin, which looks, when magnified, not unlike a little dish filled with miniature strawberries. The bees were not seen to gather spores from these clusters, but the grains carried to the hives were positively identified by comparison with fresh specimens from the leaves. This presumably unwholesome food seemed to have no unfavorable effect on the health of the infant families of bees. Whether some such strange choice of food is related to the occasional occurrence of poisonous honey, may be suggested.

Cryptogamic Parasites. — The report of M. Maxime Cornu, in the *Bulletin Entomologique*, on a larva of *Chelonia Hebe* which had been killed by a parasitic fungus, refers the fungus to the genus *Entomophthora*, and possibly to the species which preys upon flies in the autumn. The presence of this parasite in a larva he thinks has not been previously recorded. M. Cornu concludes that fungi cannot perforate healthy animal tissues, but must enter through some wound or other opening, since he has observed an Aphis of the elder infested even to the antennæ with an abundance of corpuscles of a species of *Entomophthora*, while the fifty-two young in different stages of development contained within the affected insect were all perfectly free and healthy.

Blood Globules in Typhoid Fever. — M. Cornil has found, in the blood of the spleen of patients who have died in the third week of typhoid fever, large numbers of white globules, inclosing red globules to the number of five, six, or even more in a single cell. Other cells inclosed granules of hæmatosine. Although the existence in the blood of these large cells containing red globules is nothing new, nevertheless Cornil is the first to insist upon their multiplication in typhoid fever. The mesenteric glands, according to Cornil, are always inflamed in typhoid fever, in a manner analogous to the acute or subacute inflammation due to suppurative lymphangitis. — *The Medical Record, from Lyon Médicale.*

JAMES W. QUEEN & CO. — This well-known firm has been once more dissolved, Mr. Cheyney carrying the department of philosophical apparatus with him to Bond Street, New York city. The remaining partners, S. L. Fox and W. H. Walmsley, retain the microscopical branch of the business at the old stand and under the old name. Microscopists will find G. S. Woolman in charge of their department at the New York store.

RAPHIDES IN ENCHANTER'S NIGHTSHADE. — The *Bulletin of the Torrey Botanical Club* suggests sections of the enchanter's nightshade (*Circæa Lutetiana* L.) as an interesting microscopical study, the leaves, stem, and root being crowded with raphides, and the cells of the pith being filled with small transparent ball-like bodies.

A POLARISCOPE OBJECT. — Hairs of common gromwell (*Lithospermum officinale* L.) are said to polarize beautifully under the microscope.

SCIENTIFIC NEWS.

— The following remarks by the editor of *Nature*, though referring to science in England, are not perhaps out of place in an American journal: —

"By looking to general science, again, the government avoids the difficulties which must necessarily accompany, with all the fluctuations of trade, any attempt to teach applied science except in some very general forms. The fact is that the practical applications of science bring their own reward, and need no extraneous encouragement; instruction and invention in them may very well, and without the least hardship, be left to those whose pockets they fill. Art receives ample encouragement, and is well rewarded by the nation; let but an artist in any department show himself capable of producing good work, and he will soon find that both the government and private individuals have plenty of rewards to bestow upon him. Science, on the other hand, receives not a penny in the way of assistance or reward, and yet the scientific investigator is the nation's servant and greatest benefactor. Pure scientific research is at present, like virtue, its own reward; the man who devotes himself to such research, unless he has some other means of gaining a livelihood, is likely enough to starve, for all the help he will get from his country; and yet, as it has been shown over and over again, our country's prosperity, the progress of nearly all our industries, and even the very existence of many of them, are dependent on the discoveries of the scientific investigator who pursues his research on purely scientific principles, and with no practical end whatever in view. Our country has got at least as much glory, and we venture to think more practical benefit, from achievements in the region of pure science, as from all that has been accomplished in the domain of art; and yet no helping hand is held out to those who are able and willing to do their country the highest service, but cannot, because they must drudge for a living. The domain of science is every day becoming more and more extended, her methods are becoming more and more complicated, and her instruments more and more expensive; in almost every department paths are being opened up which, if pursued to their end, would certainly lead to discoveries of vital importance to the best welfare and prosperity of the nation. Our public men are continually telling us that we are being outstripped by continental nations in fields which used to be peculiarly our own, and that simply because abroad every encouragement is given to scientific research, while here its existence is either ignored or it is regarded as a mere pastime."

— Dr. Oscar Grimm has published in Siebold and Kölliker's *Zeitschrift* a summary of the results of his investigation of the fauna of the Caspian Sea. The character of this assemblage of life has interest, says *Nature*, for the evolutionist as well as the geologist. It will afford evidence not only of modification of animal life, but also of successive changes in the physical geography of that region. Dredgings were carried on, by means of a steamer, down to one hundred and fifty fathoms, and an enormous quantity of specimens were obtained, including six new fishes, twenty species of mollusca, thirty-five species of crustacea, principally colossal forms of *Gammaridæ*, and twenty species of worms. The western part of the sea gives depths of five hundred and seventeen fathoms, and has a very abundant fauna; at one haul of the dredge in one hundred and eight fathoms, there were taken three hundred and fifty specimens of *Gammaridæ*, one hundred and fifty *Idothea entomon*, fifty colossal *Mysis*, etc. Eighty species in all are new to science.

— Professor Ernst Haeckel's work on The History of Creation, as translated by Mr. Van Rhyn, of New York, will be published early in the year by D. Appleton & Co. An English translation of Haeckel's Anthropogenie is soon to appear in London. Macmillan & Co. advertise a new edition of that choice work, White's Natural History of Selborne. They have also published A Course of Practical Instruction in Elementary Biology, by Professor Huxley and H. N. Martin (crown 8vo, 6s.); and Historia Filicum, by J. Smith, with thirty lithographic plates.

— A second meeting of those proposing to form a mountain exploration club, similar in many respects to the Alpine clubs of England and

Switzerland, was held January 12th at the Massachusetts Institute of Technology in Boston. Professor Pickering presided. Mr. S. H. Scudder, of the committee on organization, made a partial report, suggesting several names for the society or club, and defining its object to be the study of comparative geography and the scientific and æsthetic exploration of the highlands of New England and the adjacent regions.

— In Arctic Notes sent to *Land and Water* by an officer of the Pandora, the British Arctic exploring vessel, he says, "I would sooner eat seal's meat than mutton or beef." This is a little exaggerated, perhaps, but we can aver that seal's flesh has a relish to it after a day's dredging on the coast of Labrador, and a meal of boiled whale's flesh is good for a very hungry man. A well-seasoned mince pie made of whale's flesh would scarcely be distinguishable from beef pie.

— Professor Carl J. Sundevall, the venerable and distinguished ornithologist of Stockholm, has lately died. He left works on the morphology of arthropods and other subjects. The botanist, Professor F. G. Bartling, of Göttingen, died in November.

— The medal of the first class, with the diploma, awarded to Professor Hayden, in charge of the Geological Survey of the Territories, by the International Congress of Geographical Sciences which met in Paris in August, has been received through the state department. Professor Hayden has also recently received letters informing him of his election as honorary member of the Italian Geographical Society of Turin, Italy, and foreign corresponding member of the Geographical Society of Paris, France.

PROCEEDINGS OF SOCIETIES.

Academy of Sciences, St. Louis. — November 15, 1875. Professor Riley remarked that among the changes that took place in those portions of the State so thoroughly devastated by locusts last spring, none were more interesting than the wide-spread appearance of a grass (*Vilfa vaginæflora*) unnoticed in ordinary seasons. The locusts eat down the blue grass so closely that in most instances it died out, and this annual grass takes its place and grows up rapidly just at the time when most needed by stock, so that it is considered a godsend by the farmers, who generally believe that it was brought by the locusts. The seed was scattered over the land the autumn before, and the conditions were all favorable for its starting. In ordinary seasons, on the contrary, it is smothered and choked down by other plants.

December 6th. Prof. C. V. Riley made a communication on jumping seeds from California, motion being imparted to the seeds by inclosed caterpillars of a small moth (*Carpocapsa saltitans*).

December 13th. A paper entitled The Grasshoppers and the Season of 1875 was received from Prof. G. C. Broadhead.

Professor Riley read a paper on the use of Paris green as an insecticide, reciting several important experiments, from which he drew the following conclusions: —

(1.) Paris green that has been four months in the soil no longer remains as such, but passes into some less soluble state, and is unaffected by the ordinary solvents of the soil.

(2.) When applied in small quantities, such as alone are necessary in destroying injurious insects, it does not affect the health of the plant.

(3.) The power of the soil to hold arsenious acid and arsenites in insoluble form will prevent water from becoming poisoned, unless the green be used in excess of any requirement as an insecticide.

He alluded to some of the potato-bug poisons, one of which, made up of salt and arsenic, was more dangerous than others, because it was liable to be mistaken for common salt.

January 4th, annual meeting. Prof. C. V. Riley was elected president. He remarked on a new use of the wood of the American agave, as a lining for insect-boxes, instead of cork. He exhibited strips of the wood, twelve by four inches, and one half inch thick, which answer this purpose admirably, the wood being remarkably light and porous, and pins being pushed into it with great ease and held firmly. It is much cheaper than cork. The celebrated traveler, Mr. A. R. Wallace, preserved all his valuable entomological collections in the East Indies in boxes made of pieces of this wood pinned together with thorns, and it is now coming into very general use.

ACADEMY OF NATURAL SCIENCES, Philadelphia. — December 28th, annual meeting. The curators announced that the new building erected for the academy was so far completed as to be ready for the reception of its collections. The removal of the museum from the building now occupied was commenced on the 2d of November and was completed last week. It is proposed shortly to commence the removal of the library, and the curators anticipate having the new hall ready for the future meetings of the academy early in January, 1876.

The concluding thirty pages of the Proceedings for 1874, and four hundred and twenty-seven pages of the Transactions, have been published, the latter being illustrated by twenty-four lithographic plates and ninety wood-cuts. One hundred and eighty-seven pages of the quarto journal have also been issued before the completion of the illustrative plates, as advance copies of Professor Cope's paper on the Batrachia and Reptilia of Costa Rica. The report concludes with a brief notice of the important events occurring in the history of the academy during the past year, which are stated to be the reception of the I. V. Williamson Library Fund, the sale of the premises at present occupied by the society, the removal of the collections to the new building at the southwest corner of Nineteenth and Race streets, and the junction of the American Entomological Society with the academy as a section thereof.

The librarian reports that there were nineteen hundred and forty additions to the library from January 1 to November 30, 1875, being an excess of two hundred and eighty for the eleven months named over the number received during the twelve months of the preceding year. Referring to the income at the disposal of the academy for the support of the library, the report continues, "At the annual meeting, held February 16th, the treasurer announced the munificent donation by Isaiah V. Williamson, Esq., to the academy, of ground rents to the amount of twenty-five thousand dollars as a permanent fund for the use of the library. It is confidently hoped that the interest on this sum, together with the portion of the interest derived from the legacy of the late Dr. Thomas B. Wilson devoted to the same use, and amounting together to eighteen hundred dollars per annum, will be sufficient, not only to keep the library supplied with the current scientific literature, but also to enable the library committee to secure, from time to time, the many very desirable books of an earlier date which are still wanting in most of the departments."

BOSTON SOCIETY OF NATURAL HISTORY. — January 5, 1876. Prof. W. H. Niles read a paper on the evidence of a widely spread geological force, exhibited by certain rock-movements. Referring to the phenomena of spontaneous fracture and expansion of rock in a north and south direction in quarries at Monson, Mass., Groton, Conn., Berea, O., and Lemont, Ill., he inferred that they could not be due to local causes, but explained them by a north and south compression of the strata, due to the contraction of the earth, and showed the important bearing of the subject on the question of mountain-building. Mr. L. S. Burbank noticed some rare trees of the Merrimack Valley.

AMERICAN GEOGRAPHICAL SOCIETY. — December 6th. Judge Daly spoke on the progress in geographical research in Africa, with special reference to Stanley's recent explorations. He was followed by remarks from Mr. Bayard Taylor, who claimed that "Stanley's journey from Zanzibar to the Nyanza, and his exploration of the eastern shore of the lake, have never been surpassed for boldness, rapidity, and success by anything in the records of African travel."

ACADEMY OF SCIENCES, San Francisco. — December 20, 1875. *Darlingtonia Californica,* the pitcher-plant of the Pacific coast, formed the subject of a paper by Mr. Henry Edwards, who gave an account of its appearance, of its functions as a fly-trap, — though its digestive powers were questioned, — of the different insects entrapped by it, and of its distribution and habitat.

ACADEMY OF SCIENCES, New York. — December 13, 1875. Papers on A New Phosphide of Silver, and a Method of estimating Silver by Phosphorus, by Prof. W. Falke, and on a Direct Process in the Manufacture of Iron in Japan, by H. Newton, were read.

CAMBRIDGE ENTOMOLOGICAL CLUB. — December 10, 1875. Dr.

Swarts gave some account of the results arrived at in the Monograph of the *Rhynchophora* of the United States, soon to be published by Drs. LeConte and Horn.

Buffalo Society of Sciences. — December 17, 1875. A paper by Mr. Grote on Noctuidæ from the Pacific Coast of North America was read, and he remarked on a noctuid moth, *Polenta Tepperi*, from Texas.

Essex Institute, Salem, Mass. — December 6, 1875. Rev. Mr. Wright gave an account of the structure of Indian Ridge, in Andover, Mass., which he regarded as an ancient moraine.

SCIENTIFIC SERIALS.[1]

The Geographical Magazine. — December, 1875. The Arctic Expedition, V. From Ritenbink to Upernavik. The Voyage of the Challenger, by Capt. J. E. Davis. N. P. Barbot de Marny's Geological Exploration in the Region of the Amu Darye. The Basin of the Mackenzie River. The United States Geological Survey in the San Juan Country. Stanley's Exploration of the Victoria Nyanza, by E. G. Ravenstein.

Monthly Microscopical Journal. — December, 1875. On a New Method of measuring the Position of the Bands in Spectra, by H. C. Sorby. Note on the Markings of *Frustulia Saxonica*, by J. J. Woodward. The Slit as an Aid in measuring Angular Aperture, by R. Keith.

Archiv für Naturgeschichte. — On the Genital Apparatus of Spiders, by Dr. Bertkau. Natural History of the Hydrachnidæ, by P. Kramer. On the Budding of Cuninæ in the Stomach of the Geryonidæ, by B. Uljanin. Description of a Fin Whale, by G. Zaddach.

Zeitschrift für wissen. Zoölogie. (Siebold and Kölliker, editors). — November, 20, 1875. The Development of Sponges, by Oscar Schmidt. Researches on the Hexactinellidæ (Sponges), by W. Marshall.

American Journal of Science and Arts. — January. Description of some Remains of an Extinct Species of Wolf and Deer from the Lead Region of the Upper Mississippi, by J. A. Allen.

Bulletin de la Société de Géographie. — November, 1875. The Madeira and its Basin, by L'Abbé Durand. Terra del Fuego, by G. Marguin.

Journal de Zoölogie. — No. 5. The Unarmed Gephyrea, by H. Théel. The Reindeer of Prehistoric Times, by P. Gervais (the editor).

Revue Scientifique. — November 27. The Genital Organs of Decapod Crustacea, by P. Brocchi.

Globus. — No. 23. Antiquities from Utah and California.

Nature. — December 9. Eskimo Tales and Traditions.

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[1] The articles enumerated under this head will be for the most part selected.

THE

AMERICAN NATURALIST.

Vol. x. — MARCH, 1876. — No. 3.

A COLONY OF BUTTERFLIES.

BY AUG. R. GROTE.

ABOUT one hundred thousand years ago, during the decline of the ice period, a colony of butterflies settled in New England. They chose for their territory Mount Washington, in New Hampshire, and their descendants occupy the rocky summit of that mountain to this day. Mount Washington is 6293 feet high, and the White Mountain butterflies are not found below an elevation of about 5600 feet. Between this height and the cloud-capped summit, the butterflies disport during the month of July of every year. The bare and inhospitable summit affords little vegetation, but the White Mountain butterflies find there food upon which they thrive. Both Mr. Sanborn and Mr. Scudder have found the caterpillar feeding upon the sedges which grow, as best they may, in hollows and between the rocks. The brown butterfly which succeeds the caterpillar measures about one and eight tenths inches from tip to tip of the extended fore wings. Above, the wings are feebly marked ; beneath, the hind wings are crossed by a dark median band with its outer edges deeper brown and irregular, while beyond the band the wings are marbled, brown and white. Naturalists know the White Mountain butterfly by the name of *Oeneis semidea*, and its first biographer was Thomas Say, who described it in the year 1828. Previously, Mr. Thomas Nuttall, the botanist, had collected specimens of the butterfly, while Say's original figure of the species was drawn from an individual presented to him by Mr. Charles Pickering, of Salem.

It is 1800 miles west from Mount Washington to Long's Peak, Colorado. In this direction, over all the level stretch of country, no butterflies like our White Mountain butterfly are to be met with. But in Colorado, species similar to the White Mountain butterfly, if not exactly like it, are found again occupying ele-

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vated lands. To the northward it is 1000 miles to Hopedale, Labrador. and here again very similar butterflies are found living in that northern region.

This is a strange distribution for a butterfly, and so the question comes up as to the manner in which it was brought about. By comparing what has been found out with regard to past conditions of the earth and the present state of things, a solution of the question has been offered. This solution gives us the ice period in North America as the agent which has induced the present distribution of the genus to which the White Mountain butterfly belongs. And the colonization of the butterfly on our New England mountains would have been effected in this wise.

Before the ice period commenced in New England, it had gathered in the extreme north of the continent. The ice gradually and very slowly advanced year by year to the southward. Always more snow fell than was melted, and this snow stayed summer and winter, and accumulated more and more. It consolidated into *nevé* and glacial ice. Forming on the highest lands, the ice-rivers filled the ravines and joined upon the plains the main body of ice which was pressing southward from the pole. Summer and winter still alternated, but, as is the case now at the extreme north, the summers were short and the winters long. The advancing ice destroyed or drove before it the insects and animals of the warmer climates, which it chilled by its approach. But it was kind to its own children. It brought down with it its *Oeneis* butterflies and its reindeer. Before its feet it spread food for both of these, year by year, always pushing food and animals to the south. At the probable rate of less than a mile in a hundred years, it brought them at last into Virginia, from the farthest north; not the Virginia of to-day, but Virginia changed into an Arctic scene.

At length the climate changed. The point of farthest advance reached, the ice began to retrace its steps. And it called its own back with it, alluring them by their food, scattered ever farther and farther to the north. At some time the lengthening summers and shortening winters brought the main ice sheet back into New England. From Southern New York to Connecticut, to Massachusetts, to Vermont, to New Hampshire, it retreated all the way. It was as the retreat of an army with all its baggage and equipments, and in perfect order. Year by year it called upon its plants, its butterflies, its animals, and they followed in its royal train. It had overridden all obstacles, all lives and constitutions, and in its retreat it shed, over the lands which again saw the sun, floods of water, the source of fresh life and civilizations. But it was careful of its own plants and animals; they were to go back with the ice, nor be seduced by the lakes and streams its retreat unveiled, and so become companions to the mammoth. And it succeeded, for the most part, until it reached the White Mountains. Though year by year the individual butterflies perished, they planted their successors; the longer-lived reindeers laid their bones by the way, and in the Connecticut Valley itself, but fresh herds still were ready to follow the northward march of the great glacier.

Out of the valley of the White Mountains the main ice mass gradually retreated; and here it lost some of its followers. At that time the White Mountains must have presented an appearance not unlike the Alps of to-day, an aspect which, owing to their inferior elevation, they have since lost under a climate growing in warmth. The local glaciers, which then filled the ravines, attracted some of the wayward, flitting *Oeneis* butterflies by a display of the food plants which they had harbored and detained from the main glacier. Year after year the great glacier retreated farther and farther north, followed by the main body of its train, — plants, butterflies, and animals, — the while some of these foolish butterflies were beguiled by the shallow ice-rivers which then filled the ravines of Mount Washington. Return became at length impossible. They advanced behind the deceiving local glaciers step by step up the mountain-side, pushed up from below by the warm climate, which to them was uncongenial, until they reached the mountain peak, now bare of snow in the short summer. Here, blown sidewise by the wind, they patiently cling to the rocks. Or, in clear weather, on weak and careful wing, they fly from flower of stemless mountain-pink to blue-berry, swaying from their narrow tenure of the land. Drawn into the currents of air that sweep the mountain's side, they are forced downwards, to be parched in the hot valleys below. Yet they maintain themselves. They are fighting it out on that line. They are entrapped, and must die out there by natural causes unless certain entomologists sooner extirpate them by pinning them up in collections of insects. What time, in Tuckerman's Ravine, I see the ill-advised collector, net in hand, swooping down on this devoted colony of ancient lineage and more than Puritan affiliation, I wonder if, before it is too late, there will not be a law passed to protect the butterflies from the cupidity of their pursuers.

This is the story of a colony of New England butterflies. I commend this colony to the protection of all good citizens of the State of New Hampshire.

THE GAME FALCONS OF NEW ENGLAND: THE GOSHAWK.

BY W. WOOD, M. D.

ALTHOUGH this bird (*Astur atricapillus*) has not the characteristic markings of the true falcon, yet it can be trained to capture game. It was considered by Audubon, Sabine, and others to be the same as the European goshawk, which was so highly prized for sporting. Says Wilson, "If this be not the celebrated goshawk formerly so much esteemed in falconry, it is very closely allied to it." The poet Chaucer in alluding to it says, —

> "Riding on hawking by the river,
> With grey goshawk in hand."

Falconry and hawking, as defined by our lexicographers, are synonymous, but formerly birds of sport were divided into two classes, those of falconry and those of hawking. This bird came under the latter class. Mr. Pennant informs us that "the goshawk is used by the Emperor of China in his sporting excursions, and is considered the best of all hawks for falconry." The same writer further says that he "examined a specimen from America which was superior in size to the European." Whether the American and the European are identical I am unable to say; but many of our ornithologists at the present time consider them specifically distinct. Until quite recently, the tendency of ornithologists has been to make as many new species out of one bird as possible. Every change of locality necessitating a different construction of nest, and every slight change in color, arising from climacteric causes, has been seized upon to create new species. Happily for science there is now a reaction taking place among our best ornithologists. Says Professor Baird, "I take more pains now to subordinate forms once considered specific, than I do to establish them as such." It is not impossible or even improbable that our goshawk may yet be considered identical with the European species, and our perigrine falcon with its European congener. The goshawk is the handsomest of all our rapacious birds, and is so beautifully marked as to be easily distinguished from all our hawks. It is not very common in any part of the United States, but Cassin informs us that "it is apparently more abundant in Northwestern America than in any other portion of the United States." His opinion was based upon the fact of six specimens being captured by the Pacific Railroad survey parties in Washington Territory and Shoal Water Bay. It may have been abundant that season and not seen there again for many years. Professor Verrill says that "it is common in Maine, and breeds there." Mr. G. A. Boardman, of Maine, says, "It is the boldest and most common of our winter hawks."

Some winters it is abundant in Connecticut, and the most common of our hawks, and then for years not a single specimen is seen. The first specimen which I obtained in East Windsor was in the winter of 1849–50. He was caught in a trap and brought to me alive. I gave him his liberty in a room eight feet by twelve feet, with a good supply of food, which he utterly refused to touch until the thirteenth day, when he devoured an entire hen, and died the next day, a victim to his voraciousness. The next that I received were two specimens in the winter of 1859–60. Nuttall speaks of its being very rare in Massachusetts; yet in 1859–60 Hon. C. L. Flint, of that State, received twenty specimens. It did not visit us again until the winter of 1867–68. That season I mounted five specimens and sent away quite a number for exchanges. I probably received some twelve or fifteen during the winter. In the winter of 1868–69 I received nine, and in 1869–70 two specimens. Since 1870 none have been taken or seen in this section, and it may not visit us again for another decade.

The goshawk does not usually soar high, like the longer-winged hawks, nor dart upon its prey by a direct descent, as do the true falcons, but by a side glance. It is restless, seldom alighting but for a moment, except to devour its quarry, and then it stands almost erect. Its flight is so rapid that it can easily overtake the swift pigeon on the wing. Audubon relates the following fact that he was an eye-witness to: "While traveling along the Ohio I observed a goshawk give chase to a large flock of crow-blackbirds then crossing the river. The hawk approached them with the swiftness of an arrow, when the blackbirds rushed together so closely that the flock looked like a dusky ball passing through the air. On reaching the mass, he with the greatest ease seized one, then another, and another, giving each a squeeze with his talons and suffering it to drop upon the water. In this manner he had procured four or five before the poor birds reached the woods, into which they instantly plunged, when he gave up the chase, swept over the water in graceful curves, and picked up the whole of his industry, carrying each bird singly to the shore."

The goshawk is the most daring and venturesome of any of our diurnal birds of prey. A farmer who resides a few miles from my office, wishing to perpetuate the old New England custom of having a chicken pie for Thanksgiving dinner, caught some fowls, took them to a log, severed the neck of one, and threw it down beside him. In an instant a goshawk seized the struggling fowl, and flying off some ten rods, alighted and commenced devouring his prey. The boldness of the attack so astonished the farmer that he looked on with blank amazement. Recovering from his surprise, he hastened into the house and brought out his gun, which secured him both the hawk and the fowl. Another instance of still greater daring occurred near East Windsor Hill, Conn. A goshawk flew after a fowl near a dwelling-house; the door being open, the hen flew inside; the hawk followed, and seized her in the room occupied by an old gentleman and his daughter. The old man hastened to the rescue, and struck the hawk with a cane before it released its grasp. The daughter caught the hawk as it attempted to fly out of the door, and killed it.

When looking for prey it skims along near the surface of the ground with great velocity, and catches its game so quickly and easily as scarcely to be seen by the looker-on. The female is nearly one third larger than the male, and the young measures considerably more than the adult bird. I have specimens of the goshawk of all ages from the young to the adult, but am not aware that it is known when this bird arrives at adult plumage. I have kept the young in confinement until one year old without its showing the least tinge of gray or slate-color. No one but an ornithologist would ever suspect that the young and the adult belonged to the same species.

With regard to the nest of this bird, says Audubon, "The goshawk is of rare occurrence in most parts of the United States, and the districts of North America to which it usually resorts to breed are as yet unknown. Some nest within the Union, others in the British Provinces of New Brunswick and Nova Scotia, but the greater part seem to proceed farther north." The nest is said to be quite large and flat, and placed on the high branches of a tree, near the trunk, and is composed of dead twigs and coarse grass, lined with fibrous strips of plants, and sometimes with a few feathers. The goshawk lays from three to four eggs, usually of a dull bluish-white color, and slightly spotted with faint brown blotches. One of the eggs in my collection is of a dusky white color, slightly tinged with dull blue, with oblong blotches of greenish-blue, and quite granulated. The measurements of two taken from different localities are as follows: long diameter $2\frac{3}{10}$ inches, short diameter $1\frac{7}{10}$; the second one, $2\frac{1}{8}$ inches by $1\frac{5}{8}$ inches. These measurements are somewhat less, and the egg was less spherical, than the one described by Dr. Brewer in his North American Oölogy. After thirty years' observation and experience in ornithological and oölogical researches, I am satisfied that it is not wise to place too much reliance upon the measurements or number of eggs found in a nest. This is particularly the case with our rapacious birds. Take for instance the great horned owl. Audubon says that it lays from three to six eggs; another collector says it always lays two eggs. While this may seem inexplicable to some, it admits of a very easy solution. A pair of these birds will occupy the same piece of woods for years if not molested, and the collector who finds their nest will invariably find two eggs. I have found two, three, four, and five eggs in a nest of this bird in different localities. The old bird lays two eggs, while the younger bird lays the larger number and the smallest eggs. I have never seen these facts in print, and am not aware that they are known to oölogists, but they are based upon my observations and that of my collectors. They explain many seeming discrepancies, and for this reason I have digressed somewhat from my subject in order to give what I consider important facts to the oölogist, as this closes my series of articles on the game falcons of New England.

THE ORIGIN AND DEVELOPMENT OF MUSEUMS.[1]

BY DR. H. A. HAGEN.

THE second part of the seventeenth century is remarkable for the formation of academies in nearly every great city, and some, principally in Italy, were founded even a century before. The first one, the Academia Secretorum Naturæ, founded in 1560 in Rome, was soon suppressed by the popes as being dangerous. Of those founded in the seventeenth century, some were more successful, and the most prominent are still vigorous, as, for instance, the Royal Society in London, the Leopoldine Academy in

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[1] Concluded from page 89.

Germany, and the Academy of Sciences in Paris. These three, founded nearly at the same time, between 1660 and 1670, have published their valuable transactions during two centuries, containing an immense number of facts and speculations which prove clearly that union is power. The facility of publishing isolated facts, otherwise lost, advanced science and her tools, the collections, in a remarkable degree. Naturally, from this time forth, new societies were founded year by year, all doing more or less valuable service.

In the mean time a very important discovery was made, that of the microscope. Formerly, natural history consisted only of observations made with the naked eye, but now the field of observation was enlarged in a manner not dreamed of before. Of course collections, becoming by degrees living archives of science, were allowed to be established on a larger scale.

It is well known that magnifying-glasses have been found among the Assyrian relics and the ruins of Pompeii, but the use of their magnifying power is nowhere recorded, though it is probable that some of the admirable gems of the ancients were cut with the help of lenses. Spectacles, perhaps in some way known in Rome, and even used by Nero, are said to have been invented at the end of the thirteenth century in Italy. Magnifying-glasses were manufactured by Arabians, and later by Roger Bacon, but certainly not used for the purposes of natural history before the beginning of the seventeenth century. Italy and Holland dispute the honor of the invention, which was perhaps simultaneous in the two countries. The great advantages of lenses for observation were directly acknowledged, and even augmented, by the invention of the compound microscope. Fontana in Rome and Drebbel in Holland are the rival inventors.

The old fame of Italy was now declining, and religious fanaticism hindered more and more the development of science. Unfortunately, also, the famous wealth of the Italian merchants was destroyed by the refusal of a number of prominent princes to pay their debts, enormous sums of money advanced by Italian bankers. These circumstances, together with the general change of the old routes of trade, gave an important advantage to the Dutch Protestants. The easily amassed fortune was largely used to advance culture and science, and the small Dutch country became for more than a century the leading nation in fashion, taste, and science, till her French and English neighbors put themselves somewhat roughly in her place. The particular taste of the Dutch people for accurate and correct work in its exaggerated and pedantic character was well adapted for forming and arranging collections so rapidly acquired by a trade with the whole world.

Naturalists seldom equaled, never surpassed, belong to this interesting time, as Swammerdam, Leuwenhoek, Ruysch, Rumphius, Seba, and others. The observations and collections of microscopical objects by Leuwenhoek and Ruysch have till to-day a world-wide or rather a traditional fame, and are still preserved, partly in London, partly in St. Petersburg. Swammerdam himself gives an interesting account of his way of arranging and preserving the collections which were the pride and marvel of the country, seen and admired by prominent princes, who disputed among themselves the honor of acquiring them. This distinguished naturalist invented the mode of preservation of the most difficult objects by inflation, by drying, by injection, and by different chemicals.

The fame of the Dutch cabinets, as the most prominent of the time, induced Peter the Great to visit and study them carefully. A number of the most renowned, bought by him for enormous prices, were transferred to St. Petersburg to arouse an interest in such studies in his country. There are also a large number of more or less similar and expensive collections in France, Denmark, Germany, and England. The celebrated collection of Sir Hans Sloane was later the nucleus of the gigantic one of the British Museum.

Some details of the celebrated collections of Ruysch and Vincent in Amsterdam would perhaps be of interest as standard examples of the arrangement of collections at this time. The principal room is an immense hall, the high walls of which are furnished with columns, large windows in the upper part, with a gallery supported by caryatides, and the ceiling covered with rich frescoes. Shelves in the wall, or semicircular alcoves, were used for the exhibition of the objects. Large tables extending through the halls allowed of a far more detailed examination of the jars and boxes with which they were covered. Rooms connected with the halls were used for the cabinets, filled with drawers or glass jars symmetrically arranged. The latter contained birds, fishes, reptiles, the egg of a turtle with the embryo supported by the hand of a child, and a crocodile embryo in seaweed. The cover of the jar is of rich silk damask, fastened with elegant silk cords, the color of which is always reported in the description of the collection, and on the top of the cover are groups of objects arranged in the most extraordinary way; the young of the obstetrical toad dancing on the nose of their mother in extravagant attitudes, butterflies and other insects flying about bouquets of dried flowers, shells grotesquely arranged in clusters and supported by pyramids of corals, and curious dried sea-fishes or sea-urchins are fastened on the top.

The whole arrangement was such as to please the eye of the visitor, often curious, even tasteless, but according with the fashion of the time, though scarcely ever scientific except that generally animals belonging to the same classes were brought together, if the size of the animals or glass jars in which they were placed allowed of it; but this was not often the case.

Printed descriptions with the most costly engravings of the contents of the collections were published, the repeated editions of which show the interest of the public. Some of them, for instance, the plates of the cabinet of Seba, in Amsterdam, were for a long time a principal authority in natural history, and the source from which naturalists obtained their knowledge. Indeed, this time is to be considered a forerunner of Linnæus in bringing together materials which he was to classify, and thus begin a new era in the study of natural history. Considerable progress is now to be noticed in the development of collections of natural history, as well as the attempt to arrange and preserve objects in a manner to secure them against a speedy destruction.

The objects preserved in alcohol are secured by large corks, covered again by different materials to prevent the evaporation of the preserving fluid. Delicate objects, such as shells and fine corals, were placed in drawers, fixed in the bottom in artistical figures, and the insects were mostly preserved in the same way. Insect-pins did not exist till a century later, and in their stead were used needles, and formerly thorns of plants, as we find them even now in the boxes arranged in China and imported from that country. The entire boxes were protected against dust or museum pests by glass covers; or else small boxes, each containing a few insects, or only one, were arranged in larger boxes, a custom prevailing as late as the beginning of this century.

The well-known naturalist, Petiver, pressed the insects as flat as possible, and fastened them between two plates of mica pasted together by slips of paper and fastened on a leaf folded on one side of a large book. This curious collection is still preserved in the British Museum.

The observation of the biology, and the study of the anatomy, of the objects now progressed rapidly with the help of the microscope, and the works of some prominent naturalists of those times are a source of information not yet exhausted. The names of Buffon, Réaumur, Degeer, Roesel, and many others are even now the pride of science in nearly every country. The middle of the last century begins the science of the present time with the immortal works of Linnæus; immense progress was made in the century after, which he foresaw, and it would be almost superfluous to dwell uponthe merits of Linnæus.

But it seems to me that one of his innovations in science has a striking value for the advancement of collections, which has been, I believe, somewhat underrated. The invention and use of his binomial nomenclature allowed a scientific labeling of objects. Formerly all names of objects were designated by the so-called *nomen specificum* (now called a diagnosis), consisting of a dozen words. Linnæus' use of one name (he calls it a trivial one) for the species and one for the genus facilitated the labeling formerly so tedious and wordy. The advantage is obvious. The clear and logical mind of Linnæus not only purified the system, but also enabled him to purge the collections of a considerable number of fabulous and fictitious objects, sometimes a dangerous task. He was obliged to leave Hamburg suddenly, and by night, because he declared and proved the most expensive and rare object of the collection of the mayor of that city to be a fraudulent manufacture. It was a so-called hydra with many heads, the cranium having been made of weasels covered with snakes' skins. The mighty owner of this exceedingly costly object grew furious and threatened to imprison Linnæus as an impostor.

The "printed instructions" for the arrangement of a museum published by Linnæus in 1753 is the first really scientific essay, and has been followed by most naturalists. Indeed, even to-day we find the principles and rules of Linnæus more or less unconsciously followed in many museums.

Linnæus himself built at his country-seat, Hammerby, his museum, a small, square, brick building, on the top of a hill, with a beautiful view from his garden. I was fortunate enough, thirty-six years ago, to visit the place, just after the death of his youngest daughter. Everything was nearly in the same order as left by Linnæus. The collection and library, as is well known, were transferred to England. I saw them afterwards, one small cabinet containing the herbarium, and a similar one the insects and shells. This souvenir of the great man fills the heart with awe, when one considers the small number of objects forming the basis of his studies and voluminous works.

Among the numerous museums which were arranged according to his system, and described by himself and his disciples, none gratified his pride more than the collection in the Jardin du Roi, in Paris, by order of the king, and against the wishes of Linnæus' celebrated antagonist, Buffon, the director of this institution. It will not, perhaps, be out of place to quote here an account of it given in 1780 by a prominent American, in the letters of President John Adams: —

"Yesterday we went to see the garden of the king, Jardin du Roi, and his cabinet of natural history, a great collection of metals, minerals, shells, insects, birds, beasts, fishes, and precious stones. They are arranged in good order and preserved in good condition, with the name of everything beautifully written on a piece of paper annexed to it. There is also a collection of wood and marbles. The garden is large and airy, affording fine walks between rows of trees. There is a collection from all parts of the world, of all the plants, roots, and vegetables that are used in medicines, and indeed of all the plants and trees in the world. A fine scene for the studious youth in physic and philosophy. It was a public day. There was a great deal of company, and I had the opportunity only to take a cursory view. The whole is very curious. When shall we have in America such collections? I am convinced that our country affords as ample materials for collections of this nature as any part of the world."

The preëminent value of collections was first recognized when Sweden did not shrink from sending a man-of-war to recover the collections which had been sold in a legal manner to another country. The great advance made by Linnæus was followed by unusual exertions and struggles in nearly every part of the civilized world. Every country had disciples of Linnæus as leading naturalists. Everywhere collections suddenly arose, and only a score of years was needed to recognize that, with the excessive vigor of this time, science had bequeathed a new law of the highest importance for collections: the most careful preservation of described objects, nowadays called types. This new law, seemingly of very small importance, soon gained the most powerful influence over all museums, changing even their interior management and leading in a natural way to more appropriate arrangements.

It became necessary to give to one person the power to govern and direct the whole; the old custom of having a board of patrons to decide matters concerning the internal management proved to be an impediment, sometimes even a nuisance. It must not be forgotten that, in a regular meeting, the Board of the Ashmolean Museum decided that the bird No. 31 should be thrown away as a rotten object. It was the last Dodo existing. Except in England, and its present and former colonies, such boards of trustees have been abolished.

The aim to preserve everything contained in collections soon demanded a new and most important officer, called conservator. His duty is manifold and burdensome, especially in a rapidly growing museum; the most varied kinds of work belong to him, but all centring in the effort to preserve the treasures of science. In fact, the business of this officer is an art in which there are various degrees of excellence, but in which, as in other arts, no degree of excellence is to be attained without training.

There are a number of scientific matters in which nearly everybody feels himself able to have and to express an opinion, as, for instance, scientific education, local geology, primeval history, management of libraries, and evolution. The arrangement of a museum belongs to the same category, to the detriment of science, which has lost often and heavily by such volunteer efforts. The importance of thorough training for this business is shown by a large and abundant literature. The development of the art of managing collections in the manner above stated was followed, curiously enough, in a natural way by the exclusion of the non-scientific public from them. The inevitable and perhaps irreparable loss of important specimens by persons not accustomed to handle such objects and ignorant of their value, together with the impossibility of securing all objects without impeding their exhibition, was the reason for excluding everybody except naturalists. If we consider that every kind of exhibition necessitates large expenses for large rooms, and for arrangements convenient if not showy, and that just this time of progress demanded immense sums of money, the expedient resorted to will be easily understood.

With few exceptions, perhaps, for a quarter of a century most museums became so exclusive that public admission was considered a hindrance or a nuisance. Even after attempts were made to give up this exclusiveness, something of it remained, and a natural consequence of this tendency was a sort of exclusiveness in the naturalists themselves, who stood aloof with their works and collections for some time, till both were ready for the study and use of the public, just as an artist is not accessible till his work is accomplished.

The great impulse given to science by Cuvier was felt through the whole world, and every naturalist realized the necessity of a renewed and earnest study to enable him to follow the rapid progress of the master. The new way led directly to a comparative anatomy as basis for a comparative zoölogy. The admirable collections for this kind of study made and established in the Jardin des Plantes by Cuvier and his faithful associate, Laurillard, were at the time unrivaled, and show the immense amount of labor performed before the results could be published.

The aim of Cuvier was so expansive that even his masterpiece, the Règne Animal, was considered by him only as a tool necessary to be manufactured before he could work out the principles of natural history according to his ideas.

The result of this kind of revolution soon manifested itself in every museum, and the French ones under the eye of the master were far in advance. The new era developing the rights of man led directly to the necessity that everybody should be enabled to have his share in this advance of science. Museums were again thrown open to the public, and the peculiar taste for exhibition and show made the French museum, for more than a quarter of a century, the leading and most refined in the world; the other countries followed more or less slowly but steadily in their own way. It is a remarkable fact that even in the Jardin des Plantes, where the low, old-fashioned rooms were very soon overcrowded with objects, it was apparent that such a multitude of facts could be neither agreeable nor useful for public instruction. It was deemed advisable to prepare a separate collection, selected and arranged in a manner to be interesting to the public, which, being prepared according to French taste, was superior to all former ones. It is proper to mention here that just at this time, when Paris was the centre of science for the world, one of the most prominent of the army of ardent disciples of Cuvier was a young student from Neufchatel, Switzerland, — Louis Agassiz. The time of Cuvier is the date of the beginning of most of the large museums now in existence; some of them, indeed, were started before, but in a different and far inferior manner, so that few of the [illegible] could be retained when the new start began which [illegible] so powerfully those of London, Vienna, Berlin, Co- [illegible], Stockholm, Munich, and St. Petersburg.

It now became impossible for private collections to compete with the larger and steadily advancing museums, and the old custom which rich merchants had kept up for several centuries of accumulating collections began to disappear, and, to the detriment of science, was rarely renewed. Nevertheless, some of the old collections of this kind have lasted even to our times. Of private collections the museum of Sir Ashton Lever, afterwards, if I am not mistaken, united with the British Museum, was one of the most prominent, and some others known now only through printed catalogues were important.

The Ashmolean Museum, in Oxford, before it was transferred to the new rooms in 1861 was perhaps one of the most curious examples of the old style. Even in America, the East India museum in Salem, before the foundation of the Peabody Academy of Science, was a fair specimen of such collections of various objects of natural history, ethnological materials, and curiosities.

Private collections were now devoted to special classes or orders, according to the taste of the owner, and even often surpassed in their speciality larger museums. The impossibility of private students advancing natural history by means of large collections led quite naturally to associations and societies for this purpose, a considerable number of which were founded in nearly every country, so that science gained a large amount of facts, very prominent publications, and even more or less excellent collections. But soon most of them saw that their means were not adequate to their exertions. The collections suffered first, as it was not possible to maintain and preserve them in a scientific way. Later they grew to be a burden, and had to be given up more or less reluctantly, and the societies confined themselves to scientific work and publishing the results. There are a few exceptions where large means have been provided by patrons, and of these the Society of Natural History in Boston is the most prominent, and is unrivaled in its collection and manner of exhibition. Of course such societies have a task to accomplish which grows heavier every year. At any rate, science is much indebted to them for providing means for the publication of valuable matter which often would have been left unpublished without their generous help.

The public itself looked upon the ardent exertions of the naturalists with more curiosity than admiration, as the exclusiveness of science was the cause of a very moderate standard of general knowledge, till some of the most prominent workers found it advisable to put the results of their investigations into a shape which could be understood by people not scientifically trained. The pride of the century, Alexander von Humboldt, led the long series of such publications, and the interest of the public, once awakened, exceeded all expectations, so that in later times the so-called popular literature of natural history equaled or even superseded the scientific publications. Of course every museum deemed it a duty to keep pace with this interest, and opened its doors to the public. At first, things went on to the satisfaction of both parties; but by and by a natural change took place. The aim to exhibit the collections in a way pleasing and satisfactory to the public taste necessitated work often beyond the power of the officers, and to the scientific detriment of the collections. The buildings proved to be mostly too small, or at least not fit to exhibit the objects in a suitable way, and in the new ones the principal claim on the architect was often to satisfy the taste of the public by giving a beautiful view of the specimens, the interests of science being secondary. An imposing hall, with splendid galleries, staircases, and large, high rooms, was the basis of a plan for a museum. The specimens themselves were to be arranged more or less artistically: birds and butterflies first, fishes and crabs being condemned to the corners.

The three principal conditions of a building intended for a museum, convenient rooms, light, and the exhibition of the objects, had to be balanced in another way; the exhibition, as well as the light, took the heaviest share; and the latter being the greatest and most injurious enemy to the preservation of objects of natural history, the disadvantage for science increased in such museums beyond all measure. The necessity of securing specimens against injury augmented the expenses considerably, especially when all objects should be exhibited. Nevertheless the aim of public instruction could not often be attained in a way to match the exertions. The larger the collection, the smaller its value for the instruction of the public. The reason is obvious. Anybody obliged to pass about a quarter of a mile before cases with only water-fowls or sparrows, or to look at twenty thousand species of beetles of the same family, becomes bewildered and loses the connection between the different forms, the very thing for which he wished to see the museum.

Such large collections, which would be the pride and the aim of the scientific naturalist, are like a complete dictionary to the linguist; but nobody, I believe, will undertake to read a dictionary for pleasure or for general instruction. This somewhat hybrid tendency to satisfy at the same time science and the public proved to be detrimental to both these and the naturalist himself. Every country complained of the gradual conversion of scientific associations into popular audiences, with no scientific knowledge to speak of, and this had the usual effect even upon scientists.

The conclusion is very simple ; the desire of advancing science is very different from that of advancing the knowledge of the non-scientific public, and both cannot be attended to at the same time and with the same means, without hindrance and injury to one or the other. The importance of the separation of these two has, during the last score of years, been more and more fully acknowledged. The plans of several museums recently built were appropriate to different purposes, either scientific ones or those adapted to public instruction, and beautiful specimens of both these patterns are in existence.

It was certainly strange and unfitting to ask a naturalist to study in the same room an elephant and a small worm, so that rooms suitable for the best observation of both seemed to be a necessity. The plan of scientific museums provides for the comparatively small number of large animals large rooms or halls, and a series of small connected rooms, so that the different classes and orders may be kept separate, thus allowing a thoroughly scientific arrangement of the objects, not to be altered for merely showy purposes. The creation of a scientific museum requires long and hard labor of generations of naturalists, and unless scientifically separated, the largest accumulation of objects of natural history forms only a sort of store-house. A museum cannot be bought at once with money, but must be developed by steady work. The largest and most advanced museums in the world have been arranged by three or even four succeeding generations of naturalists, and are still more or less remote from the achievement of their intended perfection. The only way to hasten the work is to buy scientifically prepared collections, but the chance to do this is rare, and the difference between the objects bought and those not yet worked up often creates an unpleasant discrepancy.

The expedient of sending out persons to collect the natural objects of a number of countries for museums seems quite natural, and indeed has been resorted to in many cases. The financial result was generally unsuccessful, and the objects more expensive than the highest market price. No doubt such expeditions further and advance science to a degree not to be attained in any other way, and should therefore not be done away with. But a museum dependent for its subsistence upon certain and regular funds would be able to undertake them only rarely, and with the generous help of patrons, as is done so successfully in this country.

On the whole, a well-managed museum hardly needs these extraordinary and irregular exertions, which always retard the progress of the institution. It should not be forgotten that a museum has a great advantage over a private collection, as it is generally of no great consequence if it waits years for a favorable chance to obtain certain objects, whilst a private collection can wait only during the life-time of its possessor, or rather during his working years.

Indeed, the overwhelming number of objects obtained during the last thirty years by the steadily increasing trade with the whole world has filled every museum to overflowing, and thus retarded its progress. The scientific work is still entirely unable to keep pace with the collector. The conscientious worker in a museum suffers every day the torments of Tantalus, having before him innumerable and most interesting objects for the furtherance of science, and for excellent publications. He must therefore content himself with only putting them in the right places and on the right shelves, and has no time for scientific work if he would fulfill his duty. He is surely pardonable if he occasionally revolts, although he finds his recompense in the conviction that he is working not only for himself but for others, for the advancement of science and of culture.

The sudden and unlooked-for enlargement of the collections has another equally unexpected consequence, which has not yet been accounted for. In former times most of the specimens were dried, and natural science came to be merely a knowledge of dried skins and dried animals, and the last great zoölogist who knew nothing but the skins of animals died only thirty years ago. The enormous expense of preserving objects in alcohol became more and more embarrassing, and a large part of the income of every museum had to be expended every year for this purpose. It is easy to calculate the time when a museum will be obliged to stop its work, and even be unable to preserve the objects already in hand. Various other liquids have been tried with more or less success, and finally the fact that objects preserved in a different way were generally unfit for comparison determined collectors to return to the use of alcohol.

Natural history still consists principally in the knowledge of dead and preserved animals as seen in the museums. Eventually zoölogy became a museum zoölogy. Every worker knows the difficulty of using scientific works in comparing living or fresh specimens, though he has no difficulty at all with such as have undergone the regular museum process.

It would be unfair not to acknowledge the steps now taken by naturalists to overcome this still enormous difficulty, and the real progress already made; but nevertheless it is certainly a great advantage to science that in every museum the objects are preserved in the same way. It is therefore clearly necessary to find the easiest means of reducing the evaporation of this expensive fluid, and this attempt has been made in all European museums during the last ten years.

We have now traced the development of collections of natural history to the present time. The separation of collections to advance science from those designed to advance general knowledge will be doubtless a permanent one, and is to be considered as a sign of real progress, as a benefit to mankind. The collections designed to advance science will be archives of all that has been done in science. The better the facts of science are preserved, the better the archives will be. These collections will have only an indirect advantage for the public, just as a book is of no use before one is able to read.

The noblest aim to be fulfilled by these scientific collections is to prepare the way and show how museums intended to advance knowledge, namely, collections for public instruction, can be made and arranged so as to be best fitted for their purpose. I believe that this way will not be difficult to discover, if the purpose and the aim are clearly defined. As text-books must be adapted to the degree of knowledge of the student who is to peruse them, so must museums correspond to the average standard of knowledge in the public which visits them; and as in text-books this standard may be placed somewhat above the average knowledge, so collections should be formed which would necessitate the public to adapt itself to a higher standard — a thing mankind is always inclined to do.

It will be found impossible to arrange museums exactly fitted for every kind of knowledge. As a certain limit must be given to them, it may be best to have at least one so-called epitome-collection, in which every beginner should find, as in arithmetic, the easiest means for acquiring further knowledge. The adoption of such a principle in the arrangement of museums would be equal to the different grades of text-books for different classes of students. Only the great amount of money needed to make so many different collections, and the still greater expense of maintaining them at the proper scientific standard, will prevent the arrangement of such manifold collections, though it would be the best way to educate the public. As science is to become simpler at every step in advance, and to lift higher and higher the mystical veil now so impenetrable to those without scientific knowledge, we have a right to hope that hereafter the way indicated above will be made less expensive and rendered possible of attainment. Hence everybody is called upon to hasten the progress of science, as the most effective means for the advance of general knowledge.

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LUBBOCK'S OBSERVATIONS ON BEES AND ANTS.

THE second of Sir John Lubbock's series of Observations on Bees, Wasps, and Ants has recently been published in the *Journal of the Linnean Society*, and the following extracts may give our readers some idea of the interesting nature of his observations, which simply require a little time and patience, and could be tested and extended by one not an expert in systematic entomology or the anatomy of insects. It is surprising that there are not more observers of the habits of animals in this country, among young people. The last thing taught in our public schools is the habit of observation, the only path to reflection as well as independence in thinking.

Lubbock's earlier papers tended to show that while bees do not communicate information to one another, ants certainly have this power. Now our author publishes a series of facts, diaries of the doings of bees, which show, in his opinion, "that some bees, at any rate, do not communicate with their sisters, even if they find an untenanted comb full of honey, which to them would be a perfect Eldorado. This is the more remarkable because these bees began to work in the morning before the rest, and continued to do so even in weather which drove all the others into the shelter of the hive. That the strange bees which I have recorded should have found the honey is natural enough, because there were a good many bees about in the room."

The following fact is mentioned by F. Müller as seeming also to show a limited power of communicating facts on the part of bees: "Once," he says,[1] "I assisted at a curious contest which took place between the queen and the worker bees in one of my hives, and which throws some light on the intellectual faculties of these animals. A set of forty-seven cells had been filled, eight on a nearly completed comb, thirty-five on the following, and four around the first cell of a new comb. When the queen had laid eggs in all the cells of the two older combs, she went several times round their circumference (as she always does, in order to ascertain whether she has not forgotten any cell), and then prepared to retreat into the lower part of the breeding-room. But as she had overlooked the four cells of the new comb, the workers ran impatiently from this part to the queen, pushing her, in an odd manner, with their heads, as they did also other workers they met with. In consequence, the queen began again to go around on the two older combs; but as she did not find any cell wanting an egg, she tried to descend, but everywhere she was pushed back by the workers. This contest lasted for a rather long while, till the queen escaped without having completed her work. Thus the workers knew how to advise the queen that something was as yet to be done, but they knew not how to show her *where* it had to be done."

I have already mentioned, with reference to the attachment which bees have been said to show for one another, that though I have repeatedly seen them lick a bee which had smeared herself in honey, I never observed them show the slightest attention to any of their comrades who had been drowned in water. Far, indeed, from having been able to discover any evidence of affection among them, they appear to be thoroughly callous and utterly indifferent to one another. As already mentioned, it was necessary for me occasionally to kill a bee; but I never found that the others took the slightest notice. Thus on the 11th of October I crushed a bee close to one which was feeding, — in fact, so close that their wings touched; yet the survivor took no notice whatever of the death of her sister, but went on feeding with every appearance of composure and enjoyment, just as if nothing had happened. When the pressure was removed, she remained by the side of the corpse without the slightest appearance of apprehension, sorrow, or recognition. It was, of course, impossible for her to understand my reason for killing her companion; yet neither did she feel the slightest emotion at her sister's death, nor did she show any alarm lest the same fate should befall her also. In a second case exactly the same occurred. Again, I have several times, while a bee has been feeding, held a second bee by the leg close to her; the prisoner, of course, struggled to escape, and buzzed as loudly as she could; yet the selfish (?) eater took no notice whatever. So far, therefore, from being at all affectionate. I doubt whether bees are in the least fond of one another.

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[1] Nature, June 11, 1874.

Their devotion to their queen is generally quoted as a most characteristic trait; yet it is of the most limited character. For instance, I was anxious to change my black queen for a Ligurian; and accordingly, on the 26th of October, Mr. Hunter was good enough to bring me a Ligurian queen. We removed the old queen, and we placed her with some workers in a box containing some comb. I was obliged to leave home on the following day; but when I returned on the 30th, I found that all the bees had deserted the poor queen, who seemed weak, helpless, and miserable. On the 31st the bees were coming to some honey at one of my windows, and I placed this poor queen close to them. In alighting, several of them even touched her; yet not one of her subjects took the slightest notice of her. The same queen, when afterwards placed in the hive, immediately attracted a number of bees.

That a bee can distinguish scents is certain. On the 5th of October I put a few drops of eau de Cologne in the entrance, and immediately a number (about fifteen) of bees came out to see what was the matter. Rose-water also had the same effect; and, as will be mentioned presently, in this manner I called the bees out several times; but after a few days they took hardly any notice of the scent. For instance, on the 17th of October I tried them with twenty drops of eau de Cologne, the same quantity of essence of violet, of lavender-water, of essence of musk, of essence of patchouli, and of spirits of wine; but they took no apparent notice of any of them.

I have also made some observations with the view of ascertaining whether the same bees act as sentinels. With this object, on the 5th of October I called out the bees by placing some eau de Cologne in the entrance, and marked the first three bees that came out. At five P. M. I called them out again; about twenty came, including the three marked ones. I marked three more.

October 6th. Called them out again. Out of the first twelve, five were marked ones. I marked three more.

October 7th. Called them out at 7.30 A. M., as before. Out of irst nine, seven were marked ones.

At 5.30 P. M., called them out again. Out of six, five were marked ones.

October 8th. Called them out at 7.15. Six came out, all marked ones.

October 9th. Called them out at 6.40. Out of the first ten, eight were marked ones.

Called them out at 11.30 A. M. Out of six, three were marked. I marked the other three.

Called them out at 1.30 P. M. Out of ten, six were marked.

Called them out at 4.30. Out of ten, seven were marked.

October 10th. Called them out at 6.05 A. M. Out of six, five were marked.

Shortly afterwards I did the same again, when out of eleven, seven were marked ones.

At 5.30 P. M., called them out again. Out of seven, five were marked.

October 11th. At 6.30 A. M., called them out again. Out of nine, seven were marked.

At five P. M., called them out again. Out of seven, five were marked.

After this day they took hardly any notice of the scents.

Thus in these nine experiments, out of the ninety-seven bees which came out first, no less than seventy-one were marked ones, though out of the whole number of bees in the hive there were only twelve marked for this purpose, and, indeed, even fewer in the earlier experiments. I ought, however, to add that I generally fed the bees when I called them out.

It is sometimes said that the bees of one hive all know one another, and immediately recognize and attack any intruder from another hive. At first sight this certainly implies a great deal of intelligence. It is, however, possible that the bees of particular hives have a particular smell. Thus Langstroth, in his interesting treatise on the Honey Bee, says, "Members of different colonies appear to recognize their hive companions by the sense of smell;" and I believe that if colonies are sprinkled with scented syrup, they may generally be safely mixed. Moreover, a bee returning to its own hive with a load of treasure is a very different creature from a hungry marauder; and it is said that a bee, if laden with honey, is allowed to enter any hive with impunity. Mr. Langstroth continues, "There is an air of roguery about a thieving bee which, to the expert, is as characteristic as are the motions of a pickpocket to a skillful policeman. Its sneaking look and nervous, guilty agitation, once seen, can never be mistaken." It is at any rate natural that a bee which enters a wrong hive by accident should be much surprised and alarmed, and would thus probably betray herself.

On the whole, then, I do not attach much importance to their recognition of one another as an indication of intelligence.

I had made some observations also with the view of ascertaining whether the bees which collect honey also work in the hive and attend to the brood, or whether they devote themselves exclusively to one or other of these duties. My observations, however, were not conclusive; but some light has been thrown on the subject by Dzierzon, from which it would appear that for the first fortnight of a bee's life she attends exclusively to in-door duties, and only afterwards takes to the collection of honey and pollen. Dzierzon's statements have been confirmed by Dr. Dönhoff. On the 18th of April he introduced a Ligurian queen into a hive of black bees. The first Ligurian workers emerged on the 10th of May, and made their first appearance outside the hive on the 17th; but not until the 25th did any of the Ligurian workers appear on his feeding-troughs, which were constantly crowded with common bees, nor were any seen to visit the flowers. Repeated observations, says Dr. Dönhoff, "force me to conclude that during the first two weeks of the worker-bee's life the impulse for gathering honey and pollen does not exist, or at least is not developed, and that the development of this impulse proceeds slowly and gradually. At first the young bee will not even touch the honey presented to her; some days later she will simply taste it; and only after a lapse of time will she consume it eagerly. Two weeks elapse before she readily eats honey; and nearly three weeks pass before the *gathering* impulse is sufficiently developed to impel her to fly abroad and seek for honey and pollen among the flowers." [1]

In my first memoir I alluded to the difficulty which bees experience in finding their way about. In this respect they certainly differ considerably. Some of the bees which came out through the little postern door (already described) were able to find their way back after it had been shown to them a few times. Others were much more stupid; thus, one bee came out on the 9th, 11th, 12th, 14th, 15th, 16th, 17th, 18th, and 19th, and came to the honey; but though I repeatedly put her back through the postern, she was never able to find her way for herself.

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[1] Hive and Honey Bee, Langstroth, p. 195.

I often found that if bees which were brought to honey did not return at once, still they would do so a day or two afterwards. For instance, on July 11, 1874, a hot, thundery day, and when the bees were much out of humor, I brought twelve bees to some honey; only one came back, and that one only once; but on the following day several of them returned.

My bees sometimes ceased work at times when I could not account for their doing so. October 19th was a beautiful, sunshiny, warm day. All the morning the bees were fully active. At 11.25 I brought one to the honey-comb, and she returned at the usual intervals for a couple of hours; but after that she came no more, nor were there any other bees at work. Yet the weather was lovely, and the hive is so placed as to catch the afternoon sun.

I have made a few observations to ascertain, if possible, whether the bees generally go to the same part of the hive. Thus, —

October 5th. I took a bee out of the hive, fed her, and marked her. She went back to the same part.

October 9th. At 7.15 I took out two bees, fed and marked them. They returned; but I could not see them in the same part of the hive. One, however, I found not far off.

At 9.30, brought out four bees, fed and marked them. One returned to the same part of the hive. I lost sight of the others.

Since their extreme eagerness for honey may be attributed rather to their anxiety for the common weal than to their desire for personal gratification, it cannot fairly be imputed as greediness; still the following scene, one which most of us have witnessed, is incompatible surely with much intelligence. "The sad fate of their unfortunate companions does not in the least deter others who approach the tempting lure from madly alighting on the bodies of the dying and the dead, to share the same miserable end. No one can understand the extent of their infatuation until he has seen a confectioner's shop assailed by myriads of hungry bees. I have seen thousands strained out from the syrup in which they had perished; thousands more alighting even upon the boiling sweets; the floor covered and windows darkened with bees, some crawling, others flying, and others still so completely besmeared as to be able neither to crawl nor fly — not one in ten able to carry home its ill-gotten spoils, and yet the air filled with new hosts of thoughtless comers."[1]

If, however, bees are to be credited with any moral feelings at all, I fear the experience of all bee-keepers shows that they have no conscientious scruples about robbing their weaker brethren. "If the bees of a strong stock," says Langstroth, "once get a taste of forbidden sweets, they will seldom stop until they have tested the strength of every hive." And again, "Some bee-keepers question whether a bee that once learns to steal ever returns to honest courses." Siebold has mentioned similar facts in the case of wasps (*Polistes*).

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[1] Hive and Honey Bee, Langstroth, p. 277.

M. Forel, in his excellent work, Les Fourmis de la Suisse, asserts that ants, when they first quit the pupal state, like the bees, devote themselves to household duties and the care of the young, not taking any part in the defense of the nest until a later period of life. He has repeated many of Huber's experiments. As regards the memory of ants, he convinced himself that they recognized their companions after a separation of four months; but he believes they would not do so for more than one season. In my previous memoir I have described the behavior of ants to companions from whom they had been separated for several months, and mentioned that I could not satisfy myself as to the lively manifestations of joy and satisfaction described by Huber as being shown under such circumstances. M. Forel, in the above-mentioned work, expresses his opinion that the signs which Huber regarded as marks of affection were in reality signs of distrust and fear, which, however, were soon removed.

Ants of different nests are generally enemies; but M. Forel assures us (page 262) that when they first quit the pupa-stage, ants do not distinguish friends from foes, though three or four days are sufficient to enable them to do so. It is to be regretted that he does not give the facts on which this interesting statement is based.

The behavior of ants to one another differs very much according as they are alone or supported by numerous companions. An ant which would run away in the first case will fight bravely in the second (page 249).

MM. Forel and Ebrard both assert that if an ant is a little ill, or slightly wounded, she is carefully tended by her companions; while, on the other hand, those which are dangerously ill or wounded are carried out of the nest to die. I have not met with any cases of this kind.

Again, some days I found no ants about on my window-sill as usual, although there seemed nothing in the weather to account for it.

I quote the following in order to show the steadiness with which ants work.

July 13th. At 6.20 A. M. I put an ant to some honey; at 6.40 she went, at 7.02 she returned, and at 7.08 went away again, but not to the nest; at 7.11 she returned, and at 7.15 went away again.

At 7.27 she came back.	7.40 went.
7.49 "	8.05 "
8.14 "	8.19 "
8.31 "	8.39 "
8.43 "	8.47 "
8.55 "	9 "
9.08 "	9.10 "
9.17 "	9.26 "
9.34 "	9.40 "
9.49 "	10 "
10.11 "	10.20 "
10.27 "	10.36 "
10.44 "	10.52 "
12.52 "	12.54 "
1.03 "	1.20 "
At 1.30 she came back;	at 1.41 went.
1.51 "	2.06 "

after which I was unable to go on watching.

Another ant the same morning came to honey at 6.55 A. M., at 7.04 went away.

Returned 7.10	" 7.14 "
" 7.34	" 7.36 "
" 7.45	" 7.50 "
" 8.02	" 8.07 "
" 8.17	" 8.22 "
" 8.31	" 8.36 "
" 8.44	" 8.58 "
" 8.59	" 9 "

after which she came back no more. During this time fifteen others had come to the honey.

That ants have a certain power of communication has been proved by Huber and other observers. Several striking cases are mentioned by M. Forel. For instance (*op. cit.*, page 297), an army of Amazon ants, on an expedition in search of slaves, attacked a nest of *Formica rufibarbis.* In a few seconds (quelques secondes) the dome of the nest was covered with *F. rufibarbis*, which rushed out to defend their house.

On another occasion he placed a number of *Tetramorium cæspitum* about four inches from a colony of *Pheidole pallidula.* "En un clin d'œil," he says (page 384), "l'alarme fut répandue, et des centaines de *Pheidole* se jetèrent au devant de l'ennemi."

Again, he (page 349) placed some earth containing a number of *Tetramorium* about four inches from a nest of *Strongylognathus Huberi.* Several combats took place; but after the lapse of a few minutes (quelques minutes) a whole army of *S. Huberi* emerged and attacked the intruders.

On another occasion, some Amazon ants (page 301) were searching in vain for a nest of *Formica rufibarbis.* After a while some of them found the nest. "Immediately" (aussitôt), he says, "a signal was given, the Amazons rushed in the right direction, and pillaged the nest in spite of its inhabitants." This is a surprising statement. If it is to be taken literally, the communication cannot have been made by the antennæ; the signal can hardly have been a visible one; are we then to imagine a sound or smell to have been made use of which our auditory and olfactory nerves are incapable of perceiving? or have ants some sense which we do not possess?

It would even appear, from M. Forel's statements, that in some cases one species comprehends the signs of another. This is, of course, the case when different species live in association; but I am now speaking of hostile species. *Formica sanguinea*, he assures us, understand the signals of *F. pratensis*. "Elles savent," he says (page 359), "toujours saisir l'instant où les *pratensis* se communiquent le signal de la déroute, et elles savent s'apprendre cette découverte les unes aux autres avec une rapidité incroyable. Au moment même où l'on voit les *pratensis* se jeter les unes contre les autres en se frappant de quelques coups rapides, puis cesser toute résistance et s'enfuir en masse, on voit aussi les *sanguinea* se jeter tout-à-coup au milieu d'elles sans la plus petite retenue, mordant à droite et à gauche comme des *Polyergus*, et arrachant les cocons de toutes les *pratensis* qui en portent."

He is of opinion (page 364) that the different species differ much in their power of communicating with one another. Thus, though *Polyergus rufescens* is smaller than *F. sanguinea*, it is generally victorious, because the ants of this species understand one another more quickly than those of *F. sanguinea*.

It appeared to me that the following experiment might throw some light on the power of communication possessed by ants, namely, to place several small quantities of honey in similar situations, then to bring an ant to one of them, and subsequently to register the number of ants visiting each of the parcels of honey, of course imprisoning for the time every ant which found her way to the honey except the first. If, then, many more came to the honey which had been shown to the first ant than to the other parcels, this would be in favor of their possessing the power of communicating facts to one another, though it might be said they came by scent. Accordingly, on the 13th of July, at three P. M., I took a piece of cork about eight inches long and four inches wide, and stuck into it seventeen pins, on three of which I put pieces of card with a little honey. Up to 5.15 no ant had been up any of these pins. I then put an ant to the honey on one of the bits of card. She seemed to enjoy it; and fed for about five minutes, when she went away. At 5.30 she returned, but went up six pins which had no honey on them. I then put her on to the card.

In the mean time twelve other ants had been up wrong pins and two up to the honey; these I imprisoned for the afternoon. At 5.46 my ant went away. From that time to six o'clock, seven ants came, but not the first. One of the seven went up a wrong pin, but seemed surprised, came down, and immediately went up the right one. The other six went straight up the right pin to the honey. Up to seven o'clock twelve more ants went up pins — eight right, and four wrong. At seven, two more went wrong. Then my first ant returned, bringing three friends with her; and they all went straight to the honey. At 7.11 she went; on her way to the nest she met and spoke to two ants, both of which then came straight to the right pin and up it to the honey. Up to 7.20 seven more ants came and climbed up pins — six right, and one wrong. At 7.22 my first ant came back with five friends; at 7.30 she went away again, returning at 7.45 with no less than twenty companions. During this experiment I imprisoned every ant that found her way up to the honey. Thus, while there were seventeen pins, and consequently sixteen chances to one, yet between 5.45 and 7.45 twenty-seven ants came, not counting those which were brought by the original ant; and out of these twenty-seven, nineteen went up the right pin. Again, on the 15th of July, at 2.30, I put out the same piece of cork with ten pins, each with a piece of card and one with honey. At 4.40 I put an ant to the honey; she fed comfortably, and went away at 4.44.

At 4.45 she returned, at 5.05 went away. At 6.13 she returned; again at 6.25 and
" 5.40 " 5.55 " 6.59.

There were a good many other ants about, which, up to this time, went up the pins indiscriminately.

At 7.15 an ant came and went up the right pin, and another at 7.18. At 7.26 the first ant came back with a friend, and both went up the right pin. At 7.28 another came straight to the honey.

At 7.30 one went up a wrong pin.
" 7.31 one came to the right pin.
" 7.36 one came to the right pin with the first ant.
At 7.39 one came to the right pin.
" 7.40 " "
" 7.41 " "
" 7.43 " "
" 7.45 " "
" 7.46 " "
" " " wrong pin.
" " " "
" 7.47 two " "

At 7.48 one came to the right pin.
" " the first ant came back.
" 7.49 another came to the right pin.
" 7.50 " " wrong "
" 7.51 " " right "
" " three " wrong "
" 7.52 one " right "
" 7.55 " " wrong "
" " " " right "
" 7.57 " " wrong "
" 7.58 " " right "
" 7.59 " " wrong "

Thus after seven o'clock twenty-nine ants came; and though there were ten pins, seventeen of them went straight to the right pin.

On the 16th of July I did the same again. At 6.25 I put an ant to the honey; at 6.47 she went.

At 6.49 an ant came to the right pin.
" 6.50 another " "
" 6.55 " " "
" 6.56 " came to the wrong pin, and then to the right one.
At 6.58 another came to the right pin.
" 7 " " "
At 7.05 the first ant came back, and remained at the honey till 7.11.
At 7.05 another came to the right pin; but she was with the first.
At 7.06 another ant came to the right pin.
" 7.06 " "
" 7.12 " "
" 7.13 " "

These two ants were met by the first one, which crossed antennæ with them, when they came straight to the honey.

At 7.14 another ant came straight to the honey.
At 7.21 the first ant returned; at 7.26 she left.
At 7.24 another ant came, but went to a wrong pin, and then went on to the right one.
At 7.24 an ant came to wrong pin.
" " " " "
" " " " "
" 7.34 " " "
" 7.35 " " "
" 7.38 the first came back, at 7.45 went away again.
At 7.42 an ant went to a wrong pin.
" 7.47 " " "
" 7.48 " " "
" 7.49 " " "
" 7.52 " " the right pin.
" 7.55 the first ant returned, and at 7.56 went away again.
" 7.57 an ant went to wrong pin.
" 7.58 " right "
" 8 " wrong "
" 8 " right "
" 8.01 wrong "

After this, for an hour, no more ants came. On this occasion, therefore, while there were ten pins, out of thirty ants, sixteen came to the right one, while fourteen went to one or other of the nine wrong ones.

July 18th. I put out the boards as before at four o'clock. Up to 4.25 no ant came. I then put one (No. 1) to the honey; she fed for a few minutes, and went away at 4.31.

At 4.35 she came back with four friends, and went nearly straight to the honey. At 4.42 she went away, but came back almost directly, fed, and went away again.

At 4.57 she returned, and at 5.08 went away again.
At 4.45 an ant came to wrong pin.
" 4.47 " "
" 4.49 " "
" 4.50 " right pin.
" 4.52 " "
" 4.55 " wrong pin.
" 4.56 " right pin. This ant (No. 2) I allowed to return to the nest, which she did at 5.23.
At 5.06 an ant came to the right pin.
" 5.11 " wrong pin.
" 5.12 " right pin.
I changed the pin.
At 5.16 an ant came to the pin which I had put in the same place.
At 5.16 an ant came to the right pin.
" 5.19 " "
" 5.20 two ants " with No. 2.

At 5.20 ant No. 1 came to right pin and went at 5.25.

At 5.25 anant came to right pin; this ant had been spoken to by No. 2.

At 5.26 another ant came to right pin.
" 5.35 " "
" 5.37 " "
" 5.40 " "
" 5.41 ant No. 1 " and went at 5.49.
At 5.45 another ant "
" 5.50 " "

At 5.51 ant No. 1 came back, and at 5.54 went.

At 5.58 two ants came to the right pin.
" 5.59 another ant " "
" " " " wrong pin.

I changed the pin again.

At 6.49 an ant came to the pin which I had put in the same place.

At 7.01 another ant came to the right pin.
" 7.20 " "
" 7.33 " "
" 7.46 ant No. 1 returned, 7.55 went.

Thus during this time, from 4.50 until 7.50, twenty-nine ants came, twenty-six went to the right pin, while only three went up any of the nine wrong ones. Moreover, out of these twenty-six, only four were distinctly brought by the two ants which I had shown the honey.

On the 19th I tried a similar experiment. The marked ants frequently brought friends with them; but, without counting these, from 3.20 to eight o'clock, out of forty-five ants, twenty-nine went up the right pin, while sixteen went up the nine wrong ones.

Thus on

July 13th, of 27, 19 went right, 8 wrong.
" 15th, " 29, 17 " 12 "
" 16th, " 30, 16 " 14 "
July 18th, of 26, 23 went right, 3 wrong.
" 19th, " 45, 29 " 16 "

Or, adding them all together, while there were ten pins at least, out of one hundred and fifty-six ants one hundred and three came up the right pin, and only fifty-three up the others.

It certainly appeared to me that some of the ants were much cleverer in finding their way to the honey than others; several ants which I put on honey came back to nearly the same place, and yet did not seem able to find the exact spot.

Again, some appeared to communicate more freely with their friends than others; and I have met with cases which show that some ants certainly do not, under such circumstances, summon others to their assistance. From this point of view the following observations may be compared with those already recorded. On the 1st of August an ant came to the honey at 4.20 and went away a few minutes afterwards.

At 4.36 returned, at 4.41 went away.
" 4.52 " 4.58 "
" 5.11 " 5.15 "
" 5.30 " 5.35 "
" 6.05 " 6.10 "
At 6.21 returned, at 6.31 went away.
" 6.39 " 6.43 "
" 6.55 " 6.59 "
" 7.30 " 7.36 "
" 7.49 " 7.54 "

Yet during all this time she brought no friend with her.

The following additional observations were made after the reading of the paper, at the dates severally mentioned below.

Thus on January 3d I placed some larvæ in three small porcelain saucers in a box seven inches square attached to one of my frame nests. The saucers were in a row, six inches from the entrance to the frame and one and a half inch apart from one another.

At 1.10 an ant came to the larvæ in the cup which I will call No. 1, took a larva, and returned to the nest.

At 1.24 she returned and took another.

" 1.45 " "

" 2.10 she went to the farther saucer, No. 3. I took her up and put her to No. 1. She took a larva and returned.

At 2.24 she returned to cup No. 3. As there were only two larvæ in this cup, I left her alone. She took one and returned.

At 2.31 she returned to cup No. 3 and took the last larva.

At 2.40 she came back to cup No. 3 and searched diligently, went away and wandered about for two minutes, then returned for another look, and at length at 2.50 went to cup No. 1 and took a larva.

At 3 came to cup 1 and took a larva.

" 3.07 " "

" 3.15 " "

first, however, going and examining cup 3 again.

At 3.18 came to cup 3, then went to cup 2 and took a larva.

At 3.30 came to cup 3, then went to cup 2 and took a larva.

At 3.43 came to cup 3, then went to cup 2 and took a larva.

At 3.53 came to cup 3, but did not climb up it, then went to cup 2 and took a larva, which she either dropped or handed over to another ant; for without returning to the nest, at 3.55 she returned to the empty cup, and then to cup 2, where she took the last larva, so that two cups are now empty.

At 4.03 she came to cup 3, then to cup 2, and lastly to cup 1, when she took a larva.

At 4.15 came to cup 1 and took a larva.

" 4.22 " "

" 4.38 " "

" 5 came to cup 3, then to cup 2, and lastly to cup 1, when she took a larva.

At 5.19 came to cup 1 and took a larva.

" 5.50 came to cup 2 and then to cup 1 and took a larva.

At 6.20 came to cup 1 and took the last larva.

I now put about eighty larvæ in cup 3.

It is remarkable that during all this time she did not come straight to the cups, but took a roundabout and apparently irresolute course.

At 7.04 she came to cup 1 and then to cup 3, and then home.

There were at least a dozen ants exploring in the box; but she did not send any of them to the larvæ.

At 7.30 she returned to cup 3 and took a larva.

I now left off watching for an hour. On my return

At 8.30 she was just carrying off a larva.

At 8.40 she came back to cup 3 and took a larva.

At 8.55 she came to cup 1, then to cup 3 and took a larva.

At 9.12 she came to cup 1, then to cup 3 and took a larva.

At 9.30 she came to cup 3, then to cup 3 and took a larva.

At 9.52 she came to cup 3, then to cup 3 and took a larva.

At 10.14 she came to cup 1, then to cup 3 and took a larva.

At 10.26 she went and examined cup 2, then to cup 3 and took a larva.

At 10.45 she came to cup 3, and I went to bed. At seven o'clock the next morning the larvæ were all removed. In watching this ant I was much struck by the difficulty she seemed to experience in finding her way. She wandered about at times most irresolutely, and, instead of coming straight across from the door of the frame to the cups, kept along the side of the box; so that in coming to cup 3 she went twice as far as she need have done. Again, it is remarkable that she should have kept on visiting the empty cups time after time. I watched for this ant carefully on the following day; but she did not come out at all.

During the time she was under observation, from 1 till 10.45, though there were always ants roaming about, few climbed up the walls of the cups. Five found their way into the (empty) cup 1 and one only to cup 3. It is clear, therefore, that the ant under observation did not communicate her discovery of larvæ to her friends.

EXPLORATIONS IN COLORADO UNDER PROFESSOR HAYDEN IN 1875.

THE United States Geological and Geographical Survey of the Territories, under the direction of Professor Hayden, during the season of 1875, continued the work of the two previous seasons in Colorado, completing the southern and southwestern portions, including a belt fifteen miles in width of Northern New Mexico and Eastern Utah.

The entire force was divided into seven parties. The district surveyed by the first party, under A. D. Wilson, embraced an area of 12,400 square miles. It contains the foot-hills sloping eastward from the Front Range, the southern continuation of the Saugre de Christo Range, the southern end of the San Luis Valley, the extension of the La Plata Mountains, and the lower country of the Rio San Juan and its tributaries. A small portion of the sedimentary eastern foot-hills was first surveyed, and the work was then carried westward to the mountainous vicinity of the upper Rio Grande. Instead of forming a well-defined, sharply-limited range, the mountains south of the Rio Grande are formed by a high plateau with numerous isolated peaks. Both the plateau and the peaks mentioned are volcanic, showing the characteristic regularity of flows prevalent there. From the position of volcanic beds composing the higher peaks it may be inferred that at one time the summit of the plateau extended to a considerably higher altitude than at present. Towards the southwest it drops off suddenly into the lower country containing Rios Piedra and Pinos. Where the plateau ends, volcanic and sedimentary beds of Cretaceous age appear, extending from the Rio Animas eastward to the border of the district. Above the Cretaceous beds Nos. 2 and 3 is a series of shales and sandstones about three thousand feet in thickness, and containing coal at a number of points, of unknown geological age, though the series were thought to be possibly parallel with the Trinidad coal-bearing strata, and not of Cretaceous age.

The work was continued to the extension of the La Plata Mountains, among which evidences of former glaciers were found. In this region also there are evidences of the former existence of two very large lakes at the close of the volcanic activity there. The work was then connected to the north and northeast with that of 1874, and therewith finished.

The southwestern division, under the direction of W. H. Holmes as geologist, worked over an area of about sixty-five hundred square miles. The section of stratified rocks exposed extends from the lignitic series to the Carboniferous, including about two thousand feet of the former, and slight exposures merely of the latter. The heaviest seam of coal examined in the lignitic beds is twenty-one feet in thickness. In the Cretaceous beds fossils occurred in ten distinct horizons, which Mr. Holmes expects to be able to identify with corresponding ones on the Atlantic slope. The section obtained is the most complete and satisfactory made in Colorado up to this time.

The prehistoric remains in the cañons and lowlands of the southwest are of great interest. Many cliff houses built in extraordinary situations, and still in a fine state of preservation, were examined. A good collection of pottery, stone implements, — the latter including arrow-heads, axes, and ear-ornaments, — some pieces of ropes, fragments of matting, water-jars, corn and beans, and other articles were exhumed from the *débris* of a house. Many graves were found, and a number of skulls and skeletons that may fairly be attributed to the prehistoric inhabitants were added to the collection.

The western or Grand River division was under the charge of Henry Gannett, topographer, with A. C. Peale as geologist. The region surveyed embraces the country drained by the Uncompahgre and Dolores rivers and their branches, and the work extended about thirty miles into Utah, the total area surveyed being about six thousand square miles. The geology of this district is comparatively simple, there being no great uplifts, nor many local disturbances. The sedimentary beds are all included under the Carboniferous, Red beds (Triassic?), Jurassic, and Cretaceous series. On August 15th, the work was brought suddenly to a close by the Indians.

The work of the fourth division, directed by G. R. Bechler, extended over a large area, situated from the foot-hills of the Rocky Mountains to the Upper Arkansas and Eagle rivers, and from a point six miles south of Pike's Peak to within fifteen miles of Long's Peak, including the great mining industries of Colorado.

The party under Mr. Gardner had made but little progress when it was prevented from doing further work by the Indians. One of the stations occupied was very important, namely, the Sierra la Sal Mountain, which enabled Mr. Gardner to secure an excellent set of observations, thus extending the triangulation far into Utah, and connecting the eastern work of the survey with the great Colorado River of the West.

The trip of Mr. Jackson, the photographer of the expedition, to the southwestern portion of Colorado renewed the work of 1874 on the ancient ruins north of the present Moquis Pueblos. Interesting archæological discoveries in the upper San Juan Mesa Verdé and La Plate regions were made by Mr. W. H. Holmes, in addition to his geological work. The ruins occurred only in those cañons which had alluvial bottoms. A strip of bottom land only fifty yards in width at the bottom of the deep cañons would yield maize enough to subsist quite a town. The supposition that they belonged to an agricultural people is strengthened by the fact that in the vicinity of any group of ruins there are also a number of little "cubby-holes," too small for habitations, but very evidently intended for "caches" or granaries, and the large towns contain small apartments that must have been designed for the same use. In one place where grass, cedar, and artemisia flourish, and there is most excellent grazing land, these people must have had herds of sheep or goats which they brought up here to graze during the winter, just as the Ute and Navajos do at the present time; and the towers so frequent in this region were probably built as places of refuge or residence for the herders. Upon the faces of rock near one of these ruins is an inscription chipped in with a sharp-pointed instrument, and covering some sixty square feet of surface. Figures of goats, lizards, and human forms abound, with many hieroglyphical signs. At other points adobe houses of great extent were discovered. One town, running along the face of a perpendicular bluff for three hundred yards, contained seventy-five rooms, with granaries and cisterns. In the centre of the mass was a well-preserved circular apartment, a little below the general level of the others, which was probably an *estrefa.* The goat corrals were inside, between the houses and the bluff. In another ruined town, consisting of houses scattered up and down the De Chelly and Bonito rivers, were great reservoirs in which was found abundant and excellent water.

A week was spent by Mr. Jackson at the Moquis towns, where he obtained photographs of the houses and the inhabitants. The comparison between the work of the prehistoric town-builders and the Moquis was very much in favor of the former, the highest degree of perfection being exhibited in the cliff houses of the Rio Mancos (described in the January NATURALIST), where some of the houses were marvels of finish and durability, while in traveling to the present homes of the Moquis there was found to be a gradual merging of the ancient into the modern style, from the neatly-cut rock and correct angles of the prehistoric race to the comparatively crude buildings now made by the Moquis. Other ruins in different cañons were visited, the most extensive of which were in the cañon and valley of the Montezuma. Here the bottom of the cañons once supported a very thickly settled community. There is in one lateral cañon an almost continuous series of ruins for a distance of twenty-five miles. Throughout the lateral cañons every available defensive point has been utilized, and is now covered with the remains of heavy walls and large blocks of houses.

Another singular feature was the number of holes cut into the perpendicular lower wall of the cañon for the purpose of ascending the rock, holes just large enough to give a hand and foot hold, and leading either to some walled-up cave or to a building erected above. Some of these steps ascended the nearly perpendicular face of the rock for one hundred and fifty or two hundred feet.

The results of this trip were the collection of a large number of utensils, both modern and ancient, stone arrow and spear points, knives and axes, with photographs especially illustrative of the most important ruins, and numerous sketches of everything of note, which will be brought out in detail in the regular publications of the survey.

During the summer, Mr. P. R. Uhler and Dr. A. S. Packard, Jr., were temporarily attached to the survey, and made collections of insects in Colorado. Dr. Packard investigated the ravages of the destructive grasshopper and other injurious insects of Colorado and Utah, with a view to the preparation of a report on the injurious insects of the Territories. He also discovered a new cave-fauna on the shores of Great Salt Lake, and investigated the Alpine insects of the Rocky Mountains.

RECENT LITERATURE.

Wyman's Fresh-Water Shell-Mounds of the St. John's River, Florida.[1] — This very valuable contribution to our knowledge of the archæology of North America is modestly asserted by its lamented author to be "a record of what he has observed and a contribution to the knowledge of these ancient relics of a race which has long since passed away." It certainly is all this and more, although "still very incomplete," — a fact which goes far to show how wide a field for exploration and study is open to those devoted to archæological pursuits. The memoir opens with an admirably clear sketch of the characteristic features of the St. John's River, followed by a general description of the mounds, forty-eight in number, the majority of which are found between Lake George and Lake Harney. These shell-mounds, built up exclusively of fresh-water species, are peculiar, in being formed mainly by accumulations of Ampullarias and Paludinas, with a small percentage of mussel shells (Unios), as elsewhere these heaps are entirely formed of Unios, the other shells being either very scantily represented or altogether absent. Those here described "are in almost every case built on the banks of the river, resting either on one of the ridges of sand and river mud, ... or on land slightly raised." The accompanying plate (I.), forming the frontispiece to the memoir, illustrates the shell-mound at Old Enterprise. "From the presence of fire-places, ashes, calcined shells, charcoal, and implements, together with the bones of edible animals and occasionally those of man, found at various depths from top to bottom, and the absence of everything which might have been made by the white man, it seems certain that these mounds were the accumulations by and the dwelling-places of the earliest . . . . inhabitants, during the successive stages of their formation." As bearing upon the question of the antiquity of these mounds and their various contents of human origin, Professor Wyman remarks "that the building of the

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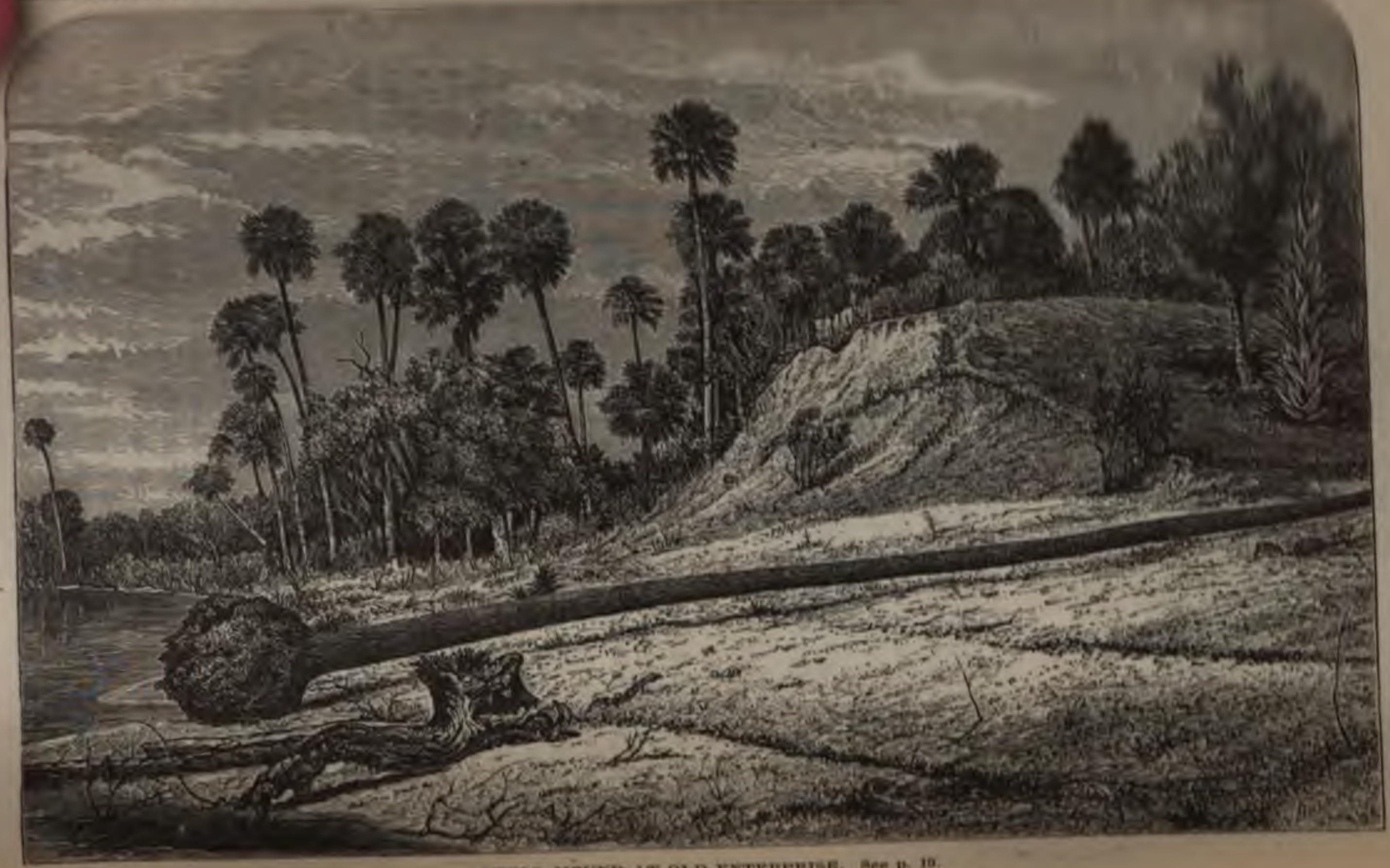
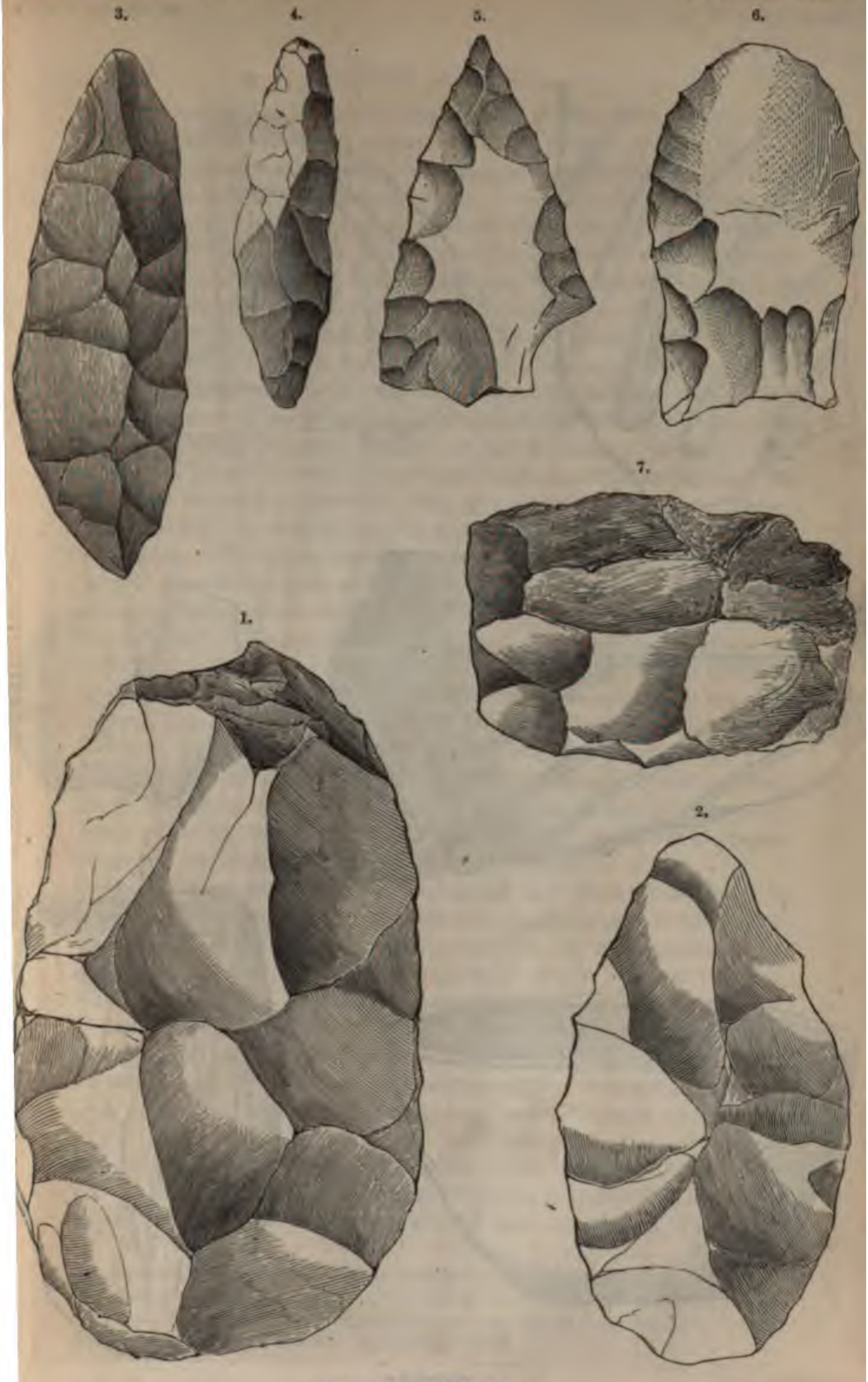
[1] *Fresh-Water Shell-Mounds of the St. John's River, Florida.* By Jeffries Wyman. Memoirs of the Peabody Academy of Science. Volume I. Number 4. Salem, Mass.: Published by the Academy. December, 1875. Royal 8vo, pp. 94. With a map and nine plates.



SHELL MOUND AT OLD ENTERPRISE. See p. 19.
Wyman's Memoir on the Fresh Water Shell Mounds of Florida.



IMPLEMENTS OF STONE.

WYMAN'S Memoir on the Fresh Water Shell Mounds of Florida.

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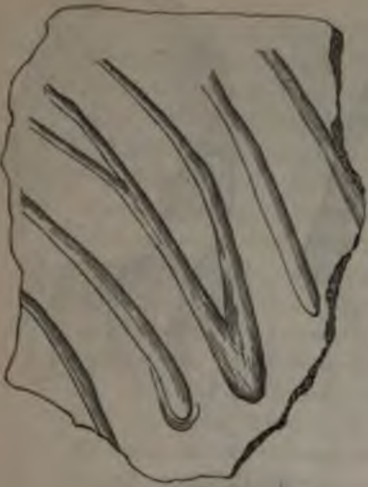

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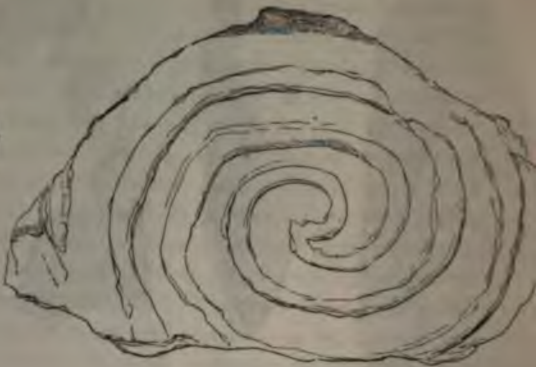

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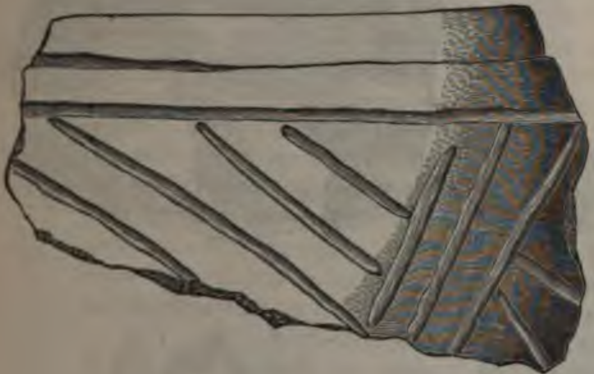

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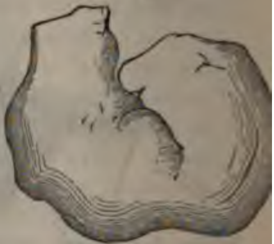

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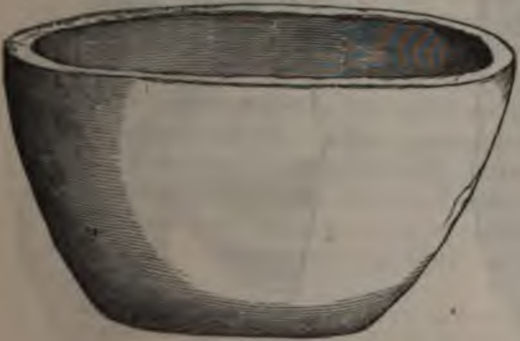

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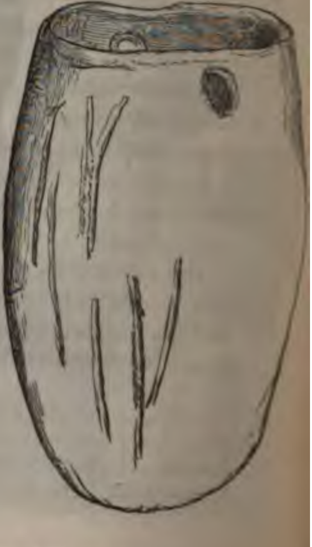

POTTERY.

WYMAN's Memoir on the Fresh Water Shell Mounds of Florida.

mounds extended through very long periods of time and were the result of very slow accumulation, or that the shells existed formerly in much greater quantities than now." Granting the probability of the latter supposition, the former seems much the more reasonable, and every fact discovered with reference to these mounds strengthens the probability, if we must so limit it, of the great age of these traces of a perished race. It is a curious fact that stone implements "were seldom met with in making excavations in the shell-mounds," inasmuch as we associate them with all early traces of human occupancy of any locality; but some few specimens were met with, and we recognize them to be such paleolithic forms as characterize the French bone caves (see Reliquiæ Aquitanicæ) and even those of an earlier date, since some are mentioned by the author as "resembling somewhat the celts of the St. Acheul pattern." The figures on Plate II., especially 1, 2, and 7, are also identical in form with the rude implements from the river gravels of the Delaware Valley (New Jersey), as comparison with specimens in the Cambridge museum will show. Here again we have an undoubted indication of the antiquity of the shell-mounds, and of their pre-Indian origin. Of the pottery it is remarked that fragments "exist in the later but not in the oldest mounds." This would indicate an acquirement of the knowledge of utilizing clay for making cooking-vessels while the mounds were in course of construction, or accumulation, and certainly the specimens from the mounds figured Plate V., figs. 3, 4, 5, and 6, are of the very rudest description, and less elaborate in ornamentation than much of the ware made by the Indians of the more northern and western States. Professor Wyman remarks that "a comparison of the pottery from the shell-heaps of the St. John's with that from other parts of Florida shows the important fact that they have but little similarity."

Besides descriptions of stone implements and those of bone and of shell, admirable chapters on pottery, human remains, traces of cannibalism, flattened tibiæ, and allied subjects, go to make up the contents of this important memoir. We have not space to allude to these in detail. Certainly no student of American archæology can do without the work, if he wishes to be well informed in this branch of the science.

MARSCHALL'S NOMENCLATOR ZOÖLOGICUS.[1] — The Zoölogical and Botanical Society of Vienna published in 1873 a Nomenclator Zoölogicus, prepared by Count Marschall, and intended to serve as a supplement to the well-known work of Agassiz. Not having been issued by a regular publishing house, the volume is less known than it would otherwise be. It purports to include all names of genera proposed for animals between 1846 and 1868, besides a few which were overlooked in the work of Agassiz. It is not, however, based upon the comprehensive plan which renders the earlier work so valuable, and is far inferior to it, not only in plan but in execution. As far as we have noticed, all names of groups higher than genera have been omitted; the value gained by their introduction would have far more than compensated for the slight additional labor required. To have added the derivations, as Agassiz did, would have so greatly augmented the labor of the compiler, besides increasing the cost of the work, that we can scarcely blame the omission, valuable as they would have been. What we deem, however, one of the prime defects of the work is that the names are not grouped in a single series, but are scattered under twenty-one distinct headings (representing as many groups of the animal kingdom), and no general index is furnished; one of the most frequent uses to which works of this nature are put is in searching whether a name which it is proposed to adopt is already in use in zoölogy; but for this, one must now look through twenty-one different lists. When we add that the work is full of misprints, has many names out of the intended alphabetical order, and is certainly by no means complete,[1] we are obliged to confess that a most useful intention has been spoiled in the accomplishment.

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[1] *Nomenclator Zoölogicus:* continens nomina systematica generum animalium tam viventium quam fossilium, secundum ordinem alphabeticum disposita sub auspiciis et sumptibus C. R. Societatis Zoölogico-Botanicæ, conscriptus a comite AUGUSTO DE MARSCHALL. 8vo, pp. vi. 482. Vindobonæ. 1873.

HENTZ'S SPIDERS OF THE UNITED STATES.[2] — Besides its regular publications of Memoirs and Proceedings, the Boston Society of Natural History publish a series of Occasional Papers. The first of these was a collection and reprint in elegant style of the miscellaneous papers of the late Dr. T. W. Harris. A more useful work is the present reprint of the papers on our spiders, by Mr. Hentz. In its present form it will be the starting-point for future studies on this subject, and prove exceedingly useful from the large number of excellent figures, which represent however, species chiefly from the Southern States. The work has passed through careful editorial hands, and the drawings and notes by Mr. Emerton add not a little to the usefulness and value of the work. A biographical sketch is given by Mr. Burgess.

MORSE'S FIRST BOOK OF ZOÖLOGY.[3] — The fact that a second edition of this attractive little book has so soon appeared is good evidence of its entire fitness as an elementary book of zoölogy. The few typographical errors which occurred in the first edition have been corrected; otherwise the book is the same, and to our mind in its present form unexceptionable as a text-book for boys and girls. We hope to see it introduced into every school in the country, for sooner or later zoölogy will have to be taught in all our common schools, at least so much of it as to cause children to collect and observe the common animals they meet with in their daily walks. An excellent feature of this book is that the child is led to examine the object and compare it with others, and is then stimulated to see how it acts, thus unconsciously getting some glimpses at least of the principles of morphology and physiology. The objects are called by their common names. The author has had the good sense to omit the scientific names, thus rendering the book vastly more attractive and useful. Many readers are anxious to first learn the Latin names, and are too often content to stop here. The scientific name is the thing of least importance. The author well illustrates, in the preface, the difficulty and mental confusion resulting from the present state of zoölogical nomenclature, the bane or necessary evil of the study of biology.

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[1] As a single instance we may cite the entire absence of the numerous genera proposed by Fieber in Lotos, during 1854. This is the more remarkable as Fieber's papers were noticed at the time in a literary review published in Count Marschall's own country, the Bericht d. Oesterreich. Literatur.

[2] *The Spiders of the United States.* A Collection of the Arachnological Writings of NICHOLAS MARCELLUS HENTZ, M. D. Edited by EDWARD BURGESS, with Notes and Descriptions by JAMES H. EMERTON. Occasional Papers of the Boston Society of Natural History. II. Boston. 1875. 8vo, pp. 117. With 21 plates. Cloth, $3.50; paper, $3.00.

[3] *First Book of Zoölogy.* By EDWARD S. MORSE, PH. D., etc. New York: D. Appleton & Co. Second Edition. 12mo, pp. 190. 1876. With many wood-cuts. $1.25.

THE MOVEMENTS AND HABITS OF CLIMBING PLANTS.[1] — We wish to refer our readers to a review of this book, and of Mr. Darwin's treatise on Insectivorous Plants, in recent numbers of the *Nation*. Our readers will recognize in the review the thorough analysis and clear statement which characterize Professor Gray's criticisms. It may be well to add to the review a single statement which is based on the opening sentences of Climbing Plants; namely, that Mr. Darwin had his attention first called to the subject several years ago, by a short paper by Professor Gray on the movement of certain tendrils.

RECENT BOOKS AND PAMPHLETS. — Natural History and Antiquities of Selborne. By Gilbert White. With Notes, by Frank Buckland; a Chapter on Antiquities, by Lord Selborne; and New Letters. Illustrated by P. H. Delamote. London: Macmillan & Co. 1875. 8vo, pp. 591. $12.00.

Norse Mythology; or the Religion of our Forefathers. Containing all the Myths of the Eddas, systematized and interpreted. With an Introduction, Vocabulary, and Index. By R. B. Anderson. Chicago: S. C. Griggs & Co. 1875. 12mo, pp. 473. $2.50.

Principal Characters of the Dinocerata. Part I. By Prof. O. C. Marsh. With six plates. (From the American Journal of Science and Arts, February, 1876.) 8vo, pp. 6.

The Microscopical Examination of Crude Drugs and other Vegetable Products. By Prof. M. W. Harrington. Ann Arbor, Mich. 8vo, pp. 34.

Fresh-Water Shell-Mounds of St. John's River, Florida. By Jeffries Wyman. (Peabody Academy of Science, Fourth Memoir.) Salem, Mass. 1875. Royal 8vo, with nine plates, pp. 94. $2.00. For sale by the Naturalist's Agency.

Harbors of Alaska, and the Tides and Currents in their Vicinity By W. H. Dall. Appendix Coast Survey Report. Washington, D. C. No. 10. 4to, pp. 36. With a sketch.

Report of Geographical and Hydrographical Explorations on the Coast of Alaska By W. H. Dall. U. S. Coast Survey. Appendix No. 11. Washington, D. C. 4to, pp. 12. With a map.

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[1] *The Movements and Habits of Climbing Plants.* By CHARLES DARWIN. London: John Murray. 1875.

Report on Mt. St. Elias. By W. H. Dall. (From the U. S. Coast Survey Report for 1875.) With a map and sketches. Washington, D. C. July, 1875. 4to, pp. 32.

Notes on the Yucca Borer (*Megathymus yuccæ*). By C. V. Riley. (Trans. Acad. Sciences, St. Louis, January, 1876.) St Louis. 1876. 8vo, pp. 23. With cuts.

Note sur les Mollusques de la Formation Post-Pliocène de l'Acadie. Par G. F. Matthew. Bruxelles. 1875. 8vo, pp. 19.

On the Surface Geology of New Brunswick. By G. F. Matthew. (Canadian Naturalist, vii., No. 8.)

Remarks on the Variation in Form of the Family Strepomatidæ. With Descriptions of New Species. By A. G. Wetherby. Cincinnati. 1875. 8vo, pp. 12. With a plate.

Descriptive Catalogues of the Photographs of the United States Geological Survey of the Territories for the Years 1869 to 1875 inclusive. Second Edition. W. H. Jackson, photographer. Washington, D. C. 1875. 8vo, pp. 81.

GENERAL NOTES.

BOTANY.[1]

Astragalus Robbinsii Gray. — As some botanists seem to suppose this plant extinct, it may be of interest to them to know that the station has never been lost, and that at any time since Oakes used to collect it until now, fine specimens have been easily obtained. It is abundant over the very limited area where it grows, and has never been found anywhere else, I believe. Few plants are so exceedingly restricted in their range, for its habitat consists only of a space about five hundred feet long and from fifty to one hundred feet wide. This is on one bank of the Winooski River, near Burlington, where the limestone ledges are overflowed by every freshet. This limestone is very hard and compact, and full of crevices which are filled with sand mixed with a little mold. In these crevices, or less often in hollows that have been filled with earth, the astragalus grows, sending its roots from six inches to a foot or even more down into the crevice. It does not, so far as I have noticed, ever grow higher on the bank of the river than the spring floods reach, nor away from the exposed limestone rock. *Potentilla fruticosa* is found abundantly in the same location, and less abundantly *Anemone multifida* and *Campanula rotundifolia*, and also several less numerous species of *Compositæ*, *Salix*, etc. — G. H. Perkins.

The Potato-Blight. — A very important step has recently been made in our knowledge of the history of this disease. It is about thirty years since it was first clearly traced by M. Montagne in France, and the Rev. M. J. Berkeley in England, to a parasitic fungus, *Botrytis* or *Peronospora infestans*, which first attacks the haulms and leaves, and eventually causes the decay of the tubers. Two modes of asexual reproduction, by means of "simple spores" or conidia, and actively moving swarmspores or zoöspores which penetrate the stomata of the host, have long been familiar to botanists; but it has been reserved for the well-known mycologist, Mr. Worthington G. Smith, of London, to discover quite recently the sexual mode of reproduction, which is quite analogous to that already known in other species of the same genus. On the mycelium, within the decaying tissues of the potato-plant, are produced the true sexual organs, the antheridia and oögonia, each of the latter containing a germinal cell or oösphere which is fertilized by a fecundating tube put out by the antheridium, which discharges its contents into the protoplasm of the oösphere, thus converting the latter into an oöspore or "resting spore." The germination of this latter body has not yet been observed. The chief point of practical importance in this discovery is that it disposes of the theory which had been started of an "alternation of generations," namely, that the spores of the potato-fungus germinate on some other plant than the potato, producing a fungus which had not been recognized as identical with the *Peronospora*, the spores of this again producing the potato-fungus. The ground which has to be worked over for the destruction of the disease is thus considerably limited. — A. W. B.

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[1] Conducted by Prof. G. L. Goodale.

NEW CLASSIFICATION OF CRYPTOGAMS. — In the last edition of his Lehrbuch der Botanik, Prof. J. Sachs proposes a new classification of the lowest section of cryptogams, which he distinguishes as *Thallophytes*, including the classes, hitherto considered distinct, of Algæ, Fungi, Lichens, and Characeæ. He divides the section into four classes, each consisting of two parallel series, the one containing chlorophyll and commonly known as Algæ (including Characeæ); the other destitute of chlorophyll and commonly known as Fungi (including Lichens). The classes are as follows: Class 1. PROTOPHYTA. This class comprises the simplest known forms of vegetable life, unicellular, or the cells connected into filaments, rarely into more complicated tissues; no mode of sexual reproduction is known. To the chlorophyll-containing series belong the *Chroococcaceæ*, *Nostocaceæ*, *Oscillatorieæ*, *Rivularieæ*, *Scytonemeæ*, and the *Palmellaceæ* (in part); to that destitute of chlorophyll the *Schigomycetes* (bacteria) and *Saccharomyces* (yeast). Class 2. TYGOSPOREÆ. Asexual propagation various; sexual propagation by means of gygospores, the result of a process of conjugation. This is divided into two sections. In the first the conjugating cells are locomotive, as in the *Volvocineæ* and *Hydrodictyeæ* (containing chlorophyll), and the *Myomycetes* (destitute of chlorophyll); the second section includes the forms in which the conjugating cells are stationary, namely, in the first series the *Conjugatæ* (comprising the *Mesocarpeæ*, *Tyguerneæ*, *Desundieæ*, and *Diatomaceæ*); in the second series the *Tygomycetes* (comprising the *Mucorim* and *Piptocephalidæ*). Class 3. OÖSPOREÆ. Reproduction by oögonia, containing an oösphere or embryonic cell, becoming an oöspore or resting-spore by the act of impregnation. In the series containing chlorophyll are *Sphæroplæa*, *Vaucheria*, the *Oedogoneæ*, and *Fucaceæ;* in the series destitute of chlorophyll the *Saprolegineæ* and *Peronosporeæ*.

Class 4. CARPOSPOREÆ. A distinct organ, or "sporocarp," results from the process of the fertilization of the female organ, or *carpogonium*. In the first series are the *Coleochætæ*, *Florideæ*, and *Characeæ ;* in the second the *Ascomycetes* (including Lichens), *Aecidiomycetes*, and *Pasidiomycetes*. This classification of the lower Cryptogams appears to be founded on sounder principles and a more thorough knowledge of their structure, and especially their mode of reproduction, than any hitherto proposed. — A. W. B.

"TWINES WITH THE SUN." — A correspondent writes to inquire whether this expression, frequently applied to certain twining plants, is correct. He suggests that it might not apply to plants growing in the southern hemisphere. The expression "with the hands of a watch" is conveniently employed in place of the above, and seems to remove all possible ambiguity. If one wishes to guard more completely against captious quibbling, he may amplify the expression thus: "in the direction taken by the hands of a watch held face upwards, in front of the observer." — L.

SETS OF NAMED FUNGI. — We are glad to be able to state to the readers of the NATURALIST that Mr. Byron D. Halsted, Assistant in Botany at the Bussey Institution, Jamaica Plain, can furnish to any who desire, at $5.00 each, sets of fungi numbering fifty well-determined specimens in each set.

BOTANICAL PRIZES. — The following prizes were awarded in 1875, by the French Academy.

The Desmazières prize in cryptogamic botany was divided between M. Émile Bescherelle for his Mosses of Mexico and New Caledonia, and M. Eugène Fournier for his Ferns of the same countries. From the report we learn that three hundred and fifty-nine species of Mexican mosses have been identified by Schimper and Bescherelle. In New Caledonia there have been found one hundred and thirty species. Fournier gives five hundred and ninety-five species of Mexican ferns, one hundred and seventy-eight of which are peculiar to Mexico. He reports two hundred and fifty-nine species of ferns in New Caledonia.

The Barbier prizes for discoveries in medicine and botany were given to Albert Robin and M. Hardy for their investigation of the new drug, jaborandi, the leaves of *Pilocarpus pinnatus*, a plant of the rue family.

BOTANICAL PAPERS IN RECENT PERIODICALS. — *American Journal of Science and Arts*, February, 1876. Dr. Gray criticises at some length a recent paper by Naudin, On the Nature of Heredity and Variability in Plants.

Bulletin of the Torrey Botanical Club, New York, January, 1876. The question of the nativity in North America of some members of the gourd family is treated of at length by J. Hammond Trumbull, and on purely philological grounds the conclusion is reached that at least species bearing Indian names were not known until they were found and described in North America. Professor Eaton describes *Ophioglossum palmatum* Plumier, a rare fern detected by Dr. Chapman in Florida. *Cyperus Wolfii* is described by A. Wood.

American Agriculturist, February, 1876. How Flowers are Fertilized, by Prof. Asa Gray (devoted to compound flowers, with cuts of Leptosyne, a plant from the sea-shore in the southern part of California).

Nature, January 13, 1876. Fertilization of Flowers by Insects, xii. Further Observations on Alpine Flowers, by Herman Müller (with cuts of the corolla of *Rhinanthus alectorolophus*).

The Canadian Journal of Science, Literature, and History, Toronto, December, 1875. Plants of the Eastern Coast of Lake Huron, by John Gibson, B. A., F. G. S., and John Macoun, M. A. (A list comprehending the Phænogams, vascular Cryptogams, and the Mosses of the eastern coast of Lake Huron, and their distribution through the northern and western portions of British North America.)

The Monthly Microscopical Journal, January, 1876. Reproduction in the Mushroom Tribe, by W. G. Smith, F. L. S. (an account of reproduction in *Coprinus radiatus*).

Comptes rendus, December 20, 1875. Remarks on the Theories of the Formation of Saccharine Matters in Plants, and especially in the Beet, by Cl. Bernard. ("In the leaves of plants there exist sometimes starch, or dextrine, or glucose, or cane sugar, or inverted sugar. What has been said relative to the transfer and transformation of these saccharoid principles from the leaves to other parts of the plant has been based on hypothetical views, and not on experiments.") Boussingault remarked that the sugar of Agave is chiefly saccharose, formed and treasured up in the leaves.

Bulletin de la Société chimique de Paris, December 20, 1875. On the Presence of a Crystallizable Sugar in Germinating Cereals, by G. Kuhnemann. (The author isolated a small amount of sugar identical with saccharose, from sprouted barley.) Researches on Sugar and Dextrin in Barley, by G. Kuhnemann. (The author found no dextrine or glucose, but a crystallizable sugar and a substance to which he gives the name *sinistrine.*)

Bulletin mensuel de la Société d'Acclimatation, September, 1875. Useful Plants of Japan, by Dr. Vidal. (This paper enumerates the plants of Japan which yield food, drugs, and useful products.)

Atti della Società Italiana di Scienze Naturali, Vol. XVII. Fasc. III., 1875. Later Observations and Considerations respecting Dichogamy in the Vegetable Kingdom, by F. Delpino. The third and fourth parts of the work noticed in the NATURALIST for January, 1876, page 42.

Ofversigt af Kongl. Vetenskaps Akad. Förhandlingar, Stockholm, 1874. Descriptions of Mosses collected by N. J. Anderson during the Voyage of the Frigate Eugenie, 1851–53, by John Angstrom. (Includes Hepaticæ as well as true Musci.)

Flora, 1875, No. 29. Dr. J. Müller gives, in the form of an analytical key, some account of new Brazilian *Rubiaceæ*. (This is continued in No. 30.) Dr. Leopold Dippel replies, with great asperity, to a recent communication by Dr. Sanio respecting the nature of the cell-wall in cambium. No. 31. Dr. Lad. Celakovsky, On the Intercalated Epipetalous Circle of Stamens (continued in No. 32, not yet finished). On the Genesis of Coloring Matters in Plants, by Dr. Carl Kraus, of Triesdorff (treating of the relations of *chromogen* to the colors of flowers, etc.). No. 33. Lindberg's new classification of the fifty-nine genera of European *Hepaticæ* is reprinted from a memoir in Acta Societatis Scientiarum Fenniæ X. President's Clark's lecture On the Circulation of Sap in Plants, 1874, is criticised at some length. The reviewer is discriminating, and points out some possible errors of interpretation, but appears to have thoroughly appreciated the wide range of experiments, and the energy with which the work was done.

Botanische Zeitung, No. 52. On the Development of Cambium, by Dr. W. Velten (examining Prof. N. J. C. Müller's views in regard to the development of Cambium). Reports of Societies: *Berlin:* Brefeld on Development of Certain Fungi. This number contains an interesting obituary notice of Dr. Bartling, author of Ordines Naturales Plantarum (1830), and professor at Göttingen. Dr. Bartling was born at Hanover, December 9, 1798, and died November 19, 1875. No. 1 (January 7, 1876). On the Influence of Light on the Color of Flowers, by E. Askenasy. (This account of experiments is not yet finished.) A few notices of plants by Ascheron. Professor Pfeffer criticises with the greatest severity, in a book-notice, the recent paper on vegetable movements, by E. Heckel, of Montpellier. He insists that Heckel has not observed ordinary caution in his work, and his results are wholly untrustworthy. A notice of the paper and the review will be soon given in a general note.

ZOÖLOGY.

BARTRAMIAN NAMES AGAIN: AN EXPLANATION.—In Dr. Coues's reply to my critique upon his article on Bartram's ornithological names he seems to have misunderstood my admissions, inasmuch as he says I have yielded the very point I wished to refute. The point at issue is not whether "Bartram's identifiable, described, and binomially named species" are entitled to recognition, for no one would be foolish enough to deny that. The few names of this character in Bartram's long list, or the "five or six" among the *twenty* (not *ten*) Dr. Coues claims as Bartramian in origin, I have of course freely admitted. But I do not see how excluding about three fourths of the names claimed by Dr. Coues as properly originating with Bartram is admitting the main point at issue, which is the recognition of species *not* identifiably described. The *real* difference between us is as to what constitutes a description. While Dr. Coues considers that such vague references to species as

"¶ *Falco pullarius*, the chicken hawk," "* *Calandra pratensis*, the May bird," "* *Passer agrestis*, the little field sparrow," etc., are to be regarded as descriptions, especially if the coincidence of favorable circumstances renders it possible to *guess* with tolerable certainty what birds were meant, I do not. Neither do I consent that names such as these, whose application is mainly determinable by a process of exclusion based on the subsequent accumulation of knowledge for three fourths of a century, shall be taken to supplant others which have become familiar through long use, and which were originally accompanied by carefully and intelligently prepared descriptions, and in many cases also by admirable figures.

If Dr. Coues had insisted on the recognition of only those Bartramian names really identifiable by Bartram's descriptions, I should have accepted them without a word of protest; but when he coupled with them three times as many more which can be determined only on some other basis, and then rarely with any degree of certainty, I deemed it an innovation not to be quietly endured. I am very glad to see that even Dr. Coues himself has abandoned this extreme ground in his reply to my critique.

In conclusion I may say that I do not feel that Dr. Coues gave the reference to Bartram's recognition of the variation in size in animals of the same species from different localities quite the consideration it merits, for Bartram not only observed the facts, but correlated them into a general statement, and even raised the inquiry whether these differences be not the result of conditions of environment, — whether "the different soil and *situation of the country* may have contributed in some measure in *forming and establishing* the difference in *size and other qualities* betwixt them." — J. A. ALLEN.

PELICANS IN SAN FRANCISCO BAY. — Pelicans (*P. fuscus*) are unusually numerous in San Francisco Bay this season, especially on the eastern side, along the Oakland shore. Recently, during a dense fog, a white pelican (*P. erythrorhyncus*) measuring ten feet from tip to tip of wings flew into the arms of a man in San Francisco. — R. E. C. STEARNS.

BEARS AND PANTHERS ON THE PACIFIC COAST. — Nine cinnamon bears were recently caught with steel traps on a ranch on the coast near Bodega Corners, Sonoma County, California; and William Bonness, a settler on the Little Chico, in Butte County, killed last month a family of California lions consisting of the parent pair and two cubs. Robert Ford also killed three in Oregon last month, and one was recently killed near Seattle, W. T., which measured nine feet four inches in length.

Deer are plentiful in San Bernardino County, and robins and larks are unusually abundant in the orchards of Santa Cruz, California. — R. E. C. STEARNS.

THE SEA-LIONS and other seals which frequent the rocky islets near the entrance to San Francisco Bay, at Point Lobos, have heretofore been protected by law, having been regarded as objects of interest and curiosity to the San Franciscans and strangers visiting the neighborhood. The Cliff House at the point is a famous resort, and the road leading to it from the city a favorite drive; these animals, which are quite numerous, are a conspicuous feature in the attractions of the locality. The state fish commissioners, who are diligently working to stock the waters of the State with food fishes, find that the results of their labors are impaired through the voracity of the seals, which occupy a station especially favorable for preying upon the finny tribe. Recently a bill has been introduced in the legislature to repeal the protective act and to encourage their extermination.

It may well be questioned, however, whether more harm is not done by the Chinese fishermen who drag the waters inside of the bay and sweep them of everything that has life, whether fish or crustaceans, without regard to "age or condition," and who dry their "catch" for export either to the interior or to their native land. The amount of fish-food and of young fish thus caught and dried is undeniably very great, and should in some manner be regulated or controlled by legislation. The papers have recently contained an account of an attack on a boat made by a sea-lion. "As a Mexican Indian named Sacramentus was crossing Tomales Bay at Marshall, the boat was attacked by a large sea-lion. The Indian dealt the beast a heavy blow on the head with a hatchet, but without repulsing the animal, which again attacked the boat, with renewed fury. It was finally killed and afterward towed ashore. The fishermen estimated its weight at twelve hundred pounds." — R. E. C. STEARNS.

EYES AND NO EYES. — In the chætopod worms of the cold deep water of the Atlantic "we miss neither the colors nor the eyes which are met with in coast regions" high north. Ehlers believes that these colors and eyes are preserved in the lightless depths in consequence of "new animals ever migrating down from the brighter layers of water, and so preventing the disappearance of these parts." As the surface animals go southward and into water warmed superficially by the Gulf Stream, they retire into the depths. To this Ranke, in the same volume (xxv.) of the *Zeitschrift für wissenschaftlich Zoölogie*, adds another pregnant suggestion as to the persistence of eyes where they seem to be useless; namely, that in leeches their very simple eyes have also sensations of touch and taste; indeed, that they are not simply eyes which may upon occasion serve other ends, but rather neutral organs of sense which can act in various directions, as needs in the long run may require. Some confirmation of this "appears partly from the fact that organs quite similar to these so-called eyes on the head of the leech occur also in the whole of the rest of the body." We take these statements from a German correspondent of *Nature*, November 25th.

REMARKABLE HABITS OF A TREE-FROG. — Professor Peters has recently described the mode of deposit of its eggs employed by a species of tree-frog (*Polypedates*) from tropical Western Africa. This species deposits its eggs, as is usual among batrachians, in a mass of albuminous jelly; but instead of placing this in the water, it attaches it to the leaves of trees which border the shore and overhang a water-hole or pond. Here the albumen speedily dries, forming a horny or glazed coating of the leaf, inclosing the unimpregnated eggs in a strong envelope. Upon the advent of the rainy season, the albumen is softened, and with the eggs is washed into the pool below, now filled with water. Here the male frog finds the masses, and occupies himself with their impregnation.

A SNAKE-EATING SNAKE. — Some years ago Professor Cope described the snake-eating habits of the *Oxyrrhopus plumbeus* Wied, a rather large species of snake which is abundant in the intertropical parts of America. A specimen of it from Martinique was observed to have swallowed the greater part of a large *fer-de-lance*, the largest venomous snake in the West Indies. The *Oxyrrhopus* had seized the *fer-de-lance* by the snout, thus preventing it from inflicting fatal wounds, and had swallowed a great part of its length, when caught and preserved by the collector. More recently a specimen was brought by Mr. Gabb from Costa Rica, almost five feet in length, which had swallowed nearly three feet of a large harmless snake (*Herpetodryas carinatus*) about six feet in length. The head was partially digested, while three feet projected from the mouth of the *Oxyrrhopus* in a sound condition. The *Oxyrrhopus* is entirely harmless, although spirited and pugnacious in its manners. Professor Cope suggests that its introduction into regions infested with venomous snakes, like the island of Martinique, would be followed by beneficial results. The East Indian snake-eater, *Naja elaps*, is unavailable for this purpose, as it is itself one of the most dangerous of venomous snakes.

ANTHROPOLOGY.

ANTHROPOLOGICAL NOTES. — In the third part of the *Bulletin de la Société d'Anthropologie* for 1875 is a paper by M. Coudereau on articulate sounds, with five tables of classification. This paper merited sufficient attention to justify the appointment of a committee consisting of MM. Chauvée, Picot, Hovelacque, Coudereau, De Caix St. Aymour, Millescamps, De Charencey, Andre Lefevre, Krishaber, Parrot, Proust, Waisse, and Onimus to examine into its merits. The same subject was discussed at subsequent meetings. In the same number, M. de Mortillet reported the reception of a letter from M. Babert de Juillé, announcing the discovery of a trepanned skull in the dolmen of Bougon in Deux Sevres. M. Broca stated that this was the fifth locality wherein this custom had been traced.

Part xvii. of Reliquiæ Aquitanicæ has been received, containing the conclusion of the paper on the Fossil Man from La Madelaine and Laugerie Basse; Notes on the Caribou of Newfoundland, by T. G. B. Lloyd; Notes on Ovibos moschatus, by E. Lartet; supplemental notes, and a series of indexes to the whole work.

In the third part of *Revue d'Anthropologie*, Dr. Berenger Feraud has a long and deeply interesting article upon the Oulofs of the Coast of Senegambia, embracing descriptions of their physical characters, manners, customs, intellectual characters, children, habitations, nourishment, language, the family and social organization.

Before the British Anthropological Institute, November 9th, Mr. Francis Galton read two papers: one on Heredity in Twins, the other on A Theory of Heredity. It appears that twin-bearing is hereditary, and that it descends through males and females about equally. In the latter paper it is argued that the germs which were selected for development into the bodily structure had a very small influence from a hereditary point of view, while it was those germs which were never developed but which remained latent, that were the real origin of the sexual element. This accounts for much that Mr. Darwin's theory of pangenesis over-accounted for, and is free from objections raised against the latter.

Dr. Robert Brown has translated Dr. Rink's celebrated work entitled Tales and Traditions of the Eskimo, with a Sketch of their Habits, Religion, Language, and other Peculiarities. Blackwood and Sons, of Edinburgh, are the publishers.

At the session of the Anthropological Section of the French Association, August 25th, M. de Mortillet advanced a new theory of the origin of bronze. After reviewing the countries where copper and tin are found, he concludes that bronze implements and weapons took their origin in India. He bases his conclusions mainly upon the following facts: Mysorine, the most reducible ore of copper, is found principally in India. In the peninsula of Malacca, and notably in the Isle of Banca, are found the richest deposits of tin in the world. The shortness of the handles of bronze weapons is paralleled by those of India at the present time. Finally, in the lacustrian deposits of the bronze age of Switzerland and Savoy, strange-shaped objects are found which have their analogues only in India. As an indication of the origin of the white-skinned races of Northern Africa, we find many of the same forms prevailing amongst them.

Among the exceedingly interesting objects brought from the Rio San Juan by Professor Hayden's party is a Peruvian double bottle or jar, similar in every respect to many of the whistling bottles of the last-named country. Whether this is an accidental resemblance or an article of commerce I am unable to say.

The Rev. M. Eells has sent to the Smithsonian Institution a manuscript of one hundred and sixty pages, containing a full account of the Twamish Indians of Hood's Canal, Puget's Sound. Nothing in connection with American ethnology is more desirable than that every Indian agent in the country would furnish us with a manuscript of the tone and tenor of this splendid work. — O. T. MASON.

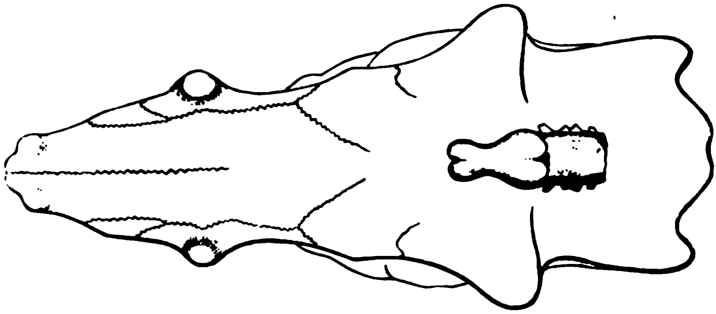
AMERICAN ARCHÆOLOGY. — Two very interesting pamphlets have been published recently in Rio Janeiro, from the pen of Professor Ch. Fred Hartt: one entitled Amazonian Tortoise Myths, the other, Notes on the Manufacture of Pottery among Savage Races. In the former we have from the Lingua Geral, or modern Tupi language, spoken at Ereré, Santarem, and on the Tapajos River, the fables founded on the exploits of the Jabuti or tortoise, and other mythical animals, — monkeys, tapirs, buzzards, etc. In the latter is an account of the process of pottery-making and ornamentation, embracing the materials, the tools, the processes, and the products, together with a copious bibliographical reference.

M. Roban, in the second number of *Le Musée Archéologique*, speaks of the handles used for flint hatchets by the ancient Mexicans. Among others he draws attention to weapons formed by inserting bits of obsidian in a grooved wooden handle, resembling the Polynesian shark's-teeth spears and swords. These obsidian weapons are described and figured in Schoolcraft, v. 290, and in the Smithsonian Contributions, vol. xi., art. ix., p. 180.

Mr. Hyde Clarke has published in pamphlet form, through Trübner & Co., an article from the *Journal of the Anthropological Institute*, entitled Researches in Prehistoric and Protohistoric Comparative Philology, Mythology, and Archæology, in connection with the Origin of Culture in America and the Accad or Sumerian Families. The design of the author is, in his own words, "to bring archaic philology into reunion with those nascent studies of anthropology, archæology, and mythology, which have met with acceptance and popularity." He has elsewhere spoken of the similarity between the Agaw of the Nile and the Abkhass of the Caucasus with the Omagua and Guarani of Brazil. He first draws attention to the Pygmæan and other so-called prehistoric races of North and South America, of Africa, and of the islands of the Pacific Ocean, and then by parallels of culture he reviews the tribes of the two hemispheres, somewhat similarly to the plan pursued by E. B. Tylor in tracing the growth of culture, and by Colonel Lane Fox in following the evolution of implements and weapons. He regards, for philological purposes, Egyptian, Sumero-Peruvian, Chinese, Tibetan, and Dravidian languages as protohistoric. In addition to resemblances of language between the continents, the author enforces his opinions by parallels of racial characters, by similar customs of head-shaping, deformations of teeth, ears, and other members, circumcision, monumental mounds, monolithic and megalithic monuments, statues, towers, and ossuaries; by their metallurgy, masonry, pottery, and weaving; by their like myths and beliefs; by their calendars, and by their social and domestic customs. The author favors the view of Mr. Park Harrison and Professor Owen that migrations to America proceeded by the Sandwich and Easter Islands as well as by Behring Strait. He concludes by affirming that "the whole of the phenomena of man in America represent an arrested development of civilization, cut short, as compared with Europe and Asia, at a time so remote that in the Old World the great religions of the globe, Judaism, Christianity, and Islam, had time to cover the Eastern hemisphere, while until the Spanish conquest the Americas had in the flux of centuries never heard their revelations." — O. T. MASON.

GEOLOGY AND PALÆONTOLOGY.

THE BRAIN OF THE DINOCERAS. — This extinct animal, discovered by Professor Marsh in the Eocene beds of Wyoming, nearly equaled the elephant in size, but the limbs were shorter. The head could reach the ground, and there is no evidence that it carried a proboscis. Professor Marsh figures the skull in his second memoir, entitled Principal Characters of the Dinocerata (*American Journal of Science*, February, 1876).



(FIG. 9.) SKULL OF DINOCERAS, SHOWING RELATIVE SIZE OF THE BRAIN.

The accompanying cut (Fig. 9) gives an outline of the skull (seen from above, one eighth the natural size) of *Dinoceras mirabile*. The central figure near the base of the skull illustrates the remarkably small brain. Says Professor Marsh, "The brain-cavity in *Dinoceras* is perhaps the most remarkable feature in this remarkable genus. It proves conclusively that the brain was proportionately smaller than in any other known mammal, recent or fossil, and even less than in some reptiles. It was, in fact, the most reptilian brain in any known mammal. In *D. mirabile* the entire brain was actually so diminutive that it could apparently have been drawn through the neural canal of all the presacral vertebræ, certainly through the cervicals and lumbars."

MOUNTAIN-MAKING. — An abstract of Professor Suess's memoir on the Origin of the Alps has been furnished the *American Journal of Science* by Mr. E. S. Dana, which we further condense, often using the ext language of the abstract. According to the views of the early geol-sts, still widely accepted, the origin of mountains is to be ascribed to elevation of a molten or semi-molten mass which threw up the rocks ng its axis, and crowded the upper strata to the right and left, forming his way a mountain-chain. But this view is not sustained by observed s, and Suess adopts the modern view of a general horizontal move- nt of the mountain system as a whole. The conclusions of Suess ee to a very considerable extent with those of Professor Dana in his ussion of mountain-making in general.

n the Alps the exertion of this horizontal force was essentially in- nced by resistance from four different sources: (1) from the presence foreign masses of older rocks; (2) from the folding mass itself; (3) n the occasional introduction of older volcanic rocks, as granite and phyry, in the moving mass; (4) finally, it appears that single mount- masses, like the Adamello or the red porphyry, near Botzen, have rted an essential influence on the development of the surrounding ntain region.

f we look at the subject more broadly, however, and pass out of ope to America, and then further study the great mountain-chains of a, we arrive at this grand conclusion: throughout, mountain-masses mountain-movements are *one-sided*, and the direction of the move- t is in general northwest, north, or northeast, in North America and ope, but southerly or southeasterly in Central Asia. There is no lar geometrical arrangement in mountain-chains.

n conclusion, it may be remarked that mountain-making as a whole be regarded as a stiffening of the earth's surface, which process has n determined by the distribution of certain older rigid masses. These be made up of mountain lines pushed up together and crossing each r, as in Bohemia, or they may consist of widely extended surfaces se strata, even the oldest, have retained their horizontal position, as ne great Russian plain. These primitive masses conform to no geo- rical law, either in outline or in distribution, though they have deter- ed the form and course of the folds which contraction has produced ne more pliant portions of the earth's surface between them.

GEOGRAPHY AND EXPLORATION.

XPLORATION OF THE UPPER MADEIRA PLATE. — Professor James on, of Vassar College, is preparing for a third expedition to South erica. He purposes to explore the unknown parts of the Upper eira Plate, the Rio Beni in particular. This magnificent river, largest tributary to the Madeira, has never been explored; its course much a geographical problem as the source of the Nile. The mys- ous Madre de Dios is supposed to be an affluent, but it remains to be ved. Lieutenant Gibbon was charged by our government to settle question, but he failed in the attempt. Professor Orton intends to nine this river mainly in the interest of geographical science; but its natural history and commercial resources will receive all possible attention. To archæologists this must be an intensely interesting field, as the Beni region was the treasure-land of the Incas; while to zoölogists it is a paradise of new forms. Said Dr. Sclater in his address before the British Association, "There is no part of South America which I would sooner suggest as a promising locality for the zoölogical collector."

THE ALEUTIAN ISLANDS. — We have received copies of a Report of Geographical and Hydrographical Explorations on the Coast of Alaska, by W. H. Dall, assistant in the Coast Survey. It is accompanied by a map of these islands on an extended scale, and contains many corrections of previous maps.

MOUNT ST. ELIAS. — In an elaborate account of Mount St. Elias printed in the forthcoming report of the Coast Survey, Mr. Dall publishes a map of the neighboring Alaskan coast, with sketches of Mount St. Elias and Mount Fairweather. The former he estimates to be 19,500 feet in height, while Mount Cook, which is sometimes mistaken for it, is 16,000 feet high. Mr. Dall thinks that Mount St. Elias is not an extinct volcano, through the great amphitheatre on the southeast flank may possibly be the crater of an extinct volcano; still this is doubtful. "Preëminent in grandeur," says Mr. Dall, "is the southern face of this mountain. With few and but insignificant foot-hills, it rises abruptly from the valley; and at about five thousand feet above its base, the entire side of the mountain is formed of an immense rock-face, inclined at an angle of 45° to the sea, rising eight or ten thousand feet without a break in its continuity. It terminates somewhat irregularly above, and the upper contours of the peak remind one of the granite peaks of the Californian Sierras. The apex is pyramidal, sharp, and clearly cut, leading to the inference that it is precipitous on the invisible northern side." There are no glaciers on the flanks of this mountain, but, owing to the topographical features of the peak, great snowfields; while there are four glaciers on Mount Fairweather, and at the head of the Bay of Yakutat, which lies between the two mountains, "glaciers come down to the sea, and send their floating fragments, laden with earth and stones, out into the sea." These glaciers have apparently always been local, as "the character of the topography is such that it is inconceivable that a continuous glacier, moving in any direction, could have ever covered the western slope of these mountains." The statement of a Russian sailor that Mount St. Elias sent forth flames and ashes is regarded as untrustworthy.

MICROSCOPY.[1]

MICROSCOPY AT THE AMERICAN ASSOCIATION. — At the Detroit meeting of the American Association for the Advancement of Science, last August, the microscopists who were in attendance decided to organize permanently a subsection or club, connected with the association.

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[1] This department is conducted by DR. R. H. WARD, Troy, N. Y.

llow ample time for preparation, and to facilitate the coöperation of
nterested parties, it was decided to adjourn for one year, and to pro-
with the organization at the Buffalo meeting of the association,
h commences on the third Wednesday of August next and continues
t one week. All persons interested in the microscope, and desirous
ining such an organization as is now proposed, are invited to be
ent and coöperate, whether at present members of the association or
and are requested to bring to the meeting original papers of scien-
interest upon subjects connected with the microscope and its work,
also to bring instruments, accessories, and objects, especially those
rating new or unfamiliar inventions, contrivances, and discoveries.

is hoped that the participation of microscopists in this movement
be prompt and cordial. The general desire for a national organiza-
has become a positive necessity, and it is believed that success could
no other way be so fully obtained as by meeting in connection with
merican Association, whose character and influence could not fail to
advantage, whose meetings are necessarily held only at the most
ble times and places, and whose elaborate arrangements for the
nience and economy of members attending are designed for the
it of scientists in every department. The recent accession of the
ists, the ethnologists, and the entomologists marks the tendency of
ssociation to become a general congress of American scientists.
eeting with the American Association the microscopists will enjoy a
than double advantage, but separated from it they would lose from
number those who desire to attend the meetings of the association
hose business or other convenience might interfere with the addi-
journey and absence demanded by a second meeting.

ERICAN POSTAL MICRO-CABINET CLUB. — A year's experience in
orking of this organization has already given it the position of a
and well-sustained institution. The first announcement of the
tion of the club was so favorably received that an unexpectedly
number of members was enrolled, since which time its member-
as steadily increased until it now numbers twelve circuits of mem-
distributed over the whole country east of the Rocky Mountains.
the exception of a remarkably small number of accidents to objects
in transit by the mails, which it is believed will be still fewer in
ture, the club has met with no practical difficulties or disappoint-
. The general excellence as well as the variety of objects con-
ed has been conspicuous; and those members, if there are any,
an learn but little from the work of others in various departments
science must at least feel that they have contributed widely to
lvantage of others at very little trouble to themselves. In addi-
the circulation and study of mounted objects, critical notes upon
me, questions and answers, and announcement of duplicates for
ge, it is proposed to add during the present year the exchange of

microscopic objects and material, whether mounted or unmounted, not necessarily connected with the slide contributed; any member adding at the bottom of his note a statement of offers or wants, and other members addressing him directly by mail, in regard to the same.

SCIENTIFIC NEWS.

—The fifth Bulletin, second series, of the United States Geological and Geographical Survey of the Territories contains the following papers: A Review of the Fossil Flora of North America, by Leo Lesquereux; Notes on the Geology of some Localities near Cañon City, by S. G. Williams; Some Account, Critical, Descriptive, and Historical, of *Zapus Hudsonius*, by Dr. Elliott Coues; On the Breeding-Habits, Nest, and Eggs of the White-Tailed Ptarmigan (*Lagopus leucurus*), by Dr. Elliott Coues; List of Hemiptera of the Region west of the Mississippi River, including those collected during the Hayden Explorations of 1873, by P. R. Uhler; On some New Species of Fossil Plants of the Lignitic Formations, by Leo Lesquereux; New Species of Fossil Plants from the Cretaceous Formation of the Dakota Group, by Leo Lesquereux; Notes on the Lignitic Group of Eastern Colorado and Wyoming, by F. V. Hayden; On the Supposed Ancient Outlet of Great Salt Lake, by A. S. Packard, Jr. The paper by Mr. Uhler occupies about a hundred pages, and contains numerous descriptions of new forms and is illustrated by three excellent plates.

—On the 13th of October, 1875, The Cincinnati Geological Society was organized with the following officers: President, Harold B. Wilson; Treasurer, Chas. Schuchert; and Recording Secretary, Chas. B. Morrell.

— A Summer School of Biology will be opened in the Museum of the Peabody Academy of Science, Salem, Mass., beginning July 7th and continuing six weeks. Especial attention will be given to marine botany and zoölogy, as the advantages for dredging and shore collecting are most excellent. The museum of the academy is situated within less than five minutes' walk of the wharves, while the cars and omnibuses run often to the beaches and good collecting-grounds. The number of students will be limited to fifteen, and while the school is designed primarily for the teachers of Essex County, Mass., a few others can be admitted. Board can be obtained for $5 a week and upwards.

Instruction in botany will be given by Mr. John Robinson, with the assistance of Mr. C. H. Higbee; and in zoölogy by A. S. Packard, Jr., with the assistance of Messrs. J. S. Kingsley and S. E. Cassino. Mr. C. Cooke will have charge of the dredging parties. Special instruction will be given in microscopy by Rev. E. C. Bolles. Prof. E. S. Morse and several other naturalists of distinction will probably give an occasional lecture. An admission fee of $10.00 will be charged. For further particulars apply to A. S. Packard, Jr., Peabody Academy of Science, Salem, Mass.

– A careful examination of the papers left at the Smithsonian Institu- by the late Dr. Stimpson has revealed the existence of the complete S. of his final report on the Crustacea of the North Pacific Exploring edition as far as the end of the Anomoura, with beautiful figures of hundred and thirty-seven of the new species. It was supposed that e had perished with Dr. Stimpson's other MSS., and with the collec- s they described, in the great Chicago fire. We trust they will soon ublished.

– Among the Swedish contributions to the Centennial Exhibition will number of articles of a fine red granite, that takes as high a polish he well-known Scotch granite, and among the manufactures of the tiful porphyry found in Elfdal, in the province of Dalarne, will be a belonging to the king, which cost ten thousand dollars. A me- ite, weighing ten thousand pounds, sent by the discoverer, Professor denskiöld, will attract notice. From the Hawaiian Islands will be to the exhibition a model of the islands, made to a scale, showing physical geography and topography, and the mountains, valleys, ds, forests, rivers, volcanoes, etc.

– Major Powell has gone West among the Indians for the purpose of ining casts of the features of the Indian tribes. He has given much tion to collecting linguistic and historical documents concerning the blos of New Mexico.

– Mr. J. Matthew Jones, of Halifax, proposes to publish shortly in *he* a list of the few insects known to inhabit the Bermudas. They mostly of a Floridan or West Indian type.

– Nordenskiöld reports that at Cape Schaitanskoj, the most northerly t on the Jenesei River, Dr. Stuxberg discovered a species of fresh- r snail (*Physa*). This is the most northerly locality for land and -water mollusks.

– Mr. J. T. Humphreys, of Atlanta, Georgia, has been appointed e Entomologist of Georgia.

– *Nelumbium luteum*, according to a popular writer in one of the thlies, is "the sacred lily of the East," is "a beautiful blossom," and said to have been introduced into this country from Europe by a ber of the Gadsden family." The latter statement is rather dis- ited by the writer, who adds that "it grows wild in Florida," and probably brought to South Carolina by Michaux. All this may be about right by a slight correction: The plant is not the sacred lily e East — meaning the Indian *Lotus ;* though a large blossom, it is beautiful ; it belongs only to this continent, and grows wild from ida to Wisconsin and Connecticut.

– The sixth Bulletin, second series, of Hayden's United States Geolog- and Geographical Survey of the Territories, finishes volume i. for and 1875. It contains the following papers : An Account of the Vari- Publications relating to the Travels of Lewis and Clarke, with a Commentary on the Zoölogical Results of their Expedition, by Dr. Elliott Coues; Notice of a very large Goniatite from Eastern Kansas, by F. B. Meek; Fossil Orthoptera from the Rocky Mountain Territories, by S. H. Scudder; Studies of the American Falconidæ, Monograph of the Polybori, by Robert Ridgway.

— At the second meeting, held in Boston, of those interested in mountain exploration, the name "Appalachian Mountain Club" was adopted. Prof. C. H. Hitchcock exhibited a model of the White Mountains, and Mr. Sweetser presented the report of the committee on the nomenclature of the White Mountains, and the club voted to adopt a number of names which the committee recommended.

PROCEEDINGS OF SOCIETIES.

Academy of Sciences, San Francisco, Cal. — December 20, 1875. A memorial to the legislature, praying that the Geological Survey be resumed, was adopted. It was stated in the memorial that there have been published four volumes of the geological reports, namely, one of geology, two of palæontology, and one of ornithology, besides smaller pamphlets and several topographical maps, the beauty, accuracy, and value of which are appreciated and acknowledged by all who have carefully examined them. Of the unpublished matter already accumulated, there is the material for a second volume of geology, for a volume of botany nearly ready to be issued, and the greater portion of the material for a second volume of ornithology, devoted to the aquatic birds. The map of Central California is so nearly finished that the active field-work of one more season would complete it. This map embraces nearly one half the area of the State, extending from Lassen's Peak on the north to Visalia on the south, and includes all the more important mining districts within the limits of California. The work so far done upon it is unexceptionable, and when completed it will possess the highest practical value, will meet with a ready sale, and will be the most important contribution to the geography of this coast that has ever been made. A general geological map of the whole State has been partially drawn and colored, and could be finished and published in such a way as to show the extent of the present knowledge of the geology of the State (subject, of course, to such improvements in detail as may hereafter be developed by future works), at no great expense. The United States Coast Survey map of the peninsula of San Francisco has been geologically colored in great detail, and only waits the means for its publication.

Philosophical Society of Washington. — January 15, 1876. Major J. W. Powell addressed the society on types of mountain-building, describing the characteristics of the mountains in the regions covered by his explorations.

January 29th. Mr. W. H. Dall read a paper on the succession in the

l-heaps of the Aleutian Islands. He showed that they were sep-
ed into three successive periods, indicated by the remains of food
ained in the shell-heaps, namely, lower or Echinus layer (Littoral
iod), composed of the remains of Echini and mollusk-shells; middle
sh-bone layer (Fishing Period), composed principally of the remains
ish; and lastly, the mammalian layer (Hunting Period), composed
cipally of bones of sea animals and birds. Above all this came the
ains of the more modern village sites.

he first period might have extended over a thousand years; the length
he others there is no means of approximating. The first layer con-
ed few and very rude implements, and a gradual progression was
rved in the variety and finish of the implements and weapons of the
eeding layers. Only toward the last were there any signs of the use
ouses, fire, or ornamentation of tools or other articles. The charac-
of the latter showed that the early inhabitants formed their tools and
pons after the Eskimo patterns, but these gradually became differ-
ated into a type peculiar to the islands. Mr. Dall considered it
able that the first inhabitants were Eskimo of a low type, who took
he islands for protection, coming from America, and in their re-
ted surroundings in the course of ages developed into a special type,
out entirely effacing the links which connect them with the Eskimo
nguage, physique, and fabrications.

r. Bessels read a paper on the hygrometric properties of the atmos-
e in the Arctic regions.

OSTON SOCIETY OF NATURAL HISTORY. — January 19th. Mr. T. T.
vé read a paper on the origin of porphyry, in which it was claimed
the rock was an altered conglomerate. Professor Hyatt exhibited
ological map of Marblehead Neck. The conglomeritic character of
porphyries of this locality were particularly dwelt upon, and a large
s of specimens exhibited. A paper by Mr. L. S. Burbank on the
lomerates of Harvard, Mass., and their relations to the crystalline
s, followed.

ebruary 2d. Dr. W. K. Brooks read a paper on the development of
ris (Columbella) *lunata*. This is the first siphonated gasteropod
se embryological history has been followed. Some general views on
molluscan pedigree were added. Mr. S. H. Scudder read a paper
he way in which cockroaches and earwigs fold their wings.

CADEMY OF NATURAL SCIENCES, Philadelphia. — February 4th.
collections of the academy are being arranged as rapidly as possible
he new building, and it is hoped that the museum will be thrown
for the inspection of the public early in the coming spring.

rofessor Cope exhibited a fragment of a leg-bone of a fossil bird dis-
red by him during the explorations in New Mexico conducted by
tenant Wheeler. It resembles in many points those of the ostrich
the extinct Dinornis of New Zealand, and its size indicates a species

twice the bulk of the former. The discovery introduces this group of birds to the known faunæ of North America, recent and extinct, and demonstrates the fact that this continent has not been destitute of the gigantic forms of birds now confined to the fauna of the southern hemisphere. A description of the fragment was given, the peculiarities which distinguish it from the corresponding part of its nearest allies were dwelt upon, and the name *Diatryma gigantea* was proposed for the form indicated by it.

Professor Frazer exhibited eight geological maps of Yesso, lately received from Benjamin Smith Lyman, Geologist-in-Chief of Japan.

Mr. Henry Carvill Lewis remarked that it might be of interest to mention the occurrence of strontianite in Pennsylvania — a mineral which he believed had not been heretofore recorded as occurring in our State. He had found it quite abundantly in Mifflin County, on the Juniata, opposite Mount Union. It exists as white tufts of rhombic crystals lining pockets in limestones, or, when in shale, disseminated throughout the rock-mass.

A paper entitled Description of a New Generic Type, *Bassaricyon Gabbii*, of the *Procyonidæ*, from Costa Rica, by J. A. Allen, was presented for publication.

CALIFORNIA ACADEMY OF SCIENCES. — At the late annual election, Prof. George Davidson was elected president. At the meeting of January 17th, Henry Edwards read descriptions of new species of Lepidoptera, and a resolution was adopted, the object of which was to sectionize the academy.

ACADEMY OF SCIENCE, St. Louis. — January 17th. Dr. Richardson exhibited a skull and some specimens of pottery obtained from a mound "near the stock-yards" at East St. Louis. The mound was about ten feet high, and forty feet in diameter at its base. At a depth of six or seven feet, eighteen skulls were found. The bodies had been laid in a circle, with the heads outward. Many of the skulls were fractured on the temporal bone. He had also found eighteen graves in the bluffs on the Belleville or "rock" road. These bones were found under slabs of stone, with some article of pottery near the head.

Mr. Theo. Allen exhibited some pottery and skulls found in mounds in Southeast Missouri. The mounds were near a swamp, and inclosed in an earth-work about a quarter of a mile square. Three mounds were opened. In only one were human remains found. Here were discovered the skulls, arms, and legs of many skeletons. No vertebræ or ribs were found. The bodies had been placed in a circle, with the heads inward. The skulls were nearly all flattened on the left side, and pressed out on the right side, but lay with the face upward. Many articles of pottery were found with the skulls. Mr. Allen stated that many of these adult skulls possess rudimentary teeth. Within the inclosure were also found many sink-holes, laid out in regular order, which had once served as

ian habitations. Specimens of dried brick which had been used to
ter over these rude habitations were also found. Mr. A. J. Conant
exhibited some skulls, and implements of bone and stone, found by
in caves in Pulaski County, Mo., on the Gasconade River.

CADEMY OF SCIENCES, New York. — January 24th. The president,
J. S. Newberry, made a communication on Fossil Fishes and Foot-
nts from the Trias of New Jersey, in which he announced his re-
overy of an old and important locality, which had been for many
s forgotten or lost. Boonton, New Jersey, lies at the junction of the
s with the gneiss range of the Highlands; and close to the village
r two adjacent beds of shale, in the Triassic sandstone. These layers
literally crowded with fishes, for the most part in a very perfect
dition, showing no traces of slow decay, but rather of sudden destruc-
and burial. Many fine specimens were procured, but only one
ies had been definitely recognized, *Catopterus gracilis.*

Ie also exhibited very fine and large tracks from the Triassic sand-
es at Pompton, a few miles from the fish locality. They have the
e characters as the three-toed reptilian foot-prints (the so-called
d-tracks") of the Connecticut Valley. The evidence is ample that
great tribe of bird-like reptiles had a very considerable development
ur American Mesozoic, reaching on well into the Cretaceous in the
s of Hadrosaurus and Lælaps.

rof. D. S. Martin presented an account of the Occurrence of Silurian
sils in the Drift of Long Island. The fossils are characteristic Bra-
pods of the Delthyris shaly limestone (especially *Strophodonta Beckii*
S. Headleyana) from a large bowlder in the heavy drift of Long Isl-
, at Willett's Point. A like circumstance has lately been noted in the
ceedings of the Philadelphia Academy, — the finding of Oneida and
lina bowlders at West Philadelphia. The questions arising are the
e in the two cases, namely, as to whether the transporting agent was
ier-ice or bergs. If the former, the distance over which the ice-
t actually moved (in the present case nearly one hundred miles) is
e beyond our usual estimate, at least in this region, and would also
ire that the glacier should have overridden the range of the Blue
ge Highlands entirely. On the other hand, if icebergs were the
its, they must needs have passed through the narrow gaps in that
ge now occupied by the Hudson, in this instance, and by the Dela-
e, Lehigh, or Schuylkill, in the other. The finding of some oysters
arently *O. borealis*) with the Long Island bowlder would indicate
rly that floating ice was the agency of transportation.

Ir. Henry Newton, of the United States Black Hills Expedition,
ibited a large series of rocks and of Cretaceous and Jurassic fossils,
ected by the party last summer, and described their occurrence some-
t in detail. The rocks included Potsdam sandstone, Huronian slates,
granites of two very distinct types; one of these Mr. Newton re-

gards as Laurentian, and the other as eruptive, and subsequent to the deposition of the Potsdam, at least, as that rock contains no fragments of it, though full of pebbles from the Huronian.

TROY SCIENTIFIC ASSOCIATION. — January 17th, annual meeting. Dr. R. H. Ward was elected president, and Rev. A. B. Hervey and Wm. E. Hagen vice-presidents. Dr. Ward delivered an address on the Petrified Forest of California. He considered the peculiar fracture of the fallen petrified trunks their most suggestive and important peculiarity since they are broken up somewhat symmetrically in a manner that might happen to wood rendered brittle by charring or perhaps by partial petrifaction, but could hardly be conceived as occurring to ordinary wood or stone.

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SCIENTIFIC SERIALS.[1]

QUARTERLY JOURNAL OF MICROSCOPICAL SCIENCE. — January. On the Structure of Hyaline Cartilage, by G. Thin. Further Observations on a Peach or Red Colored Bacterium, by E. R. Lankester. On the Development of Teeth, by C. S. Tomes. An Account of Professor Haeckel's Recent Additions to the Gastræa Theory, by E. R. Lankester. On the Evolution of Hæmoglobin, by H. C. Sorby.

THE MONTHLY MICROSCOPICAL JOURNAL. — January. Improved Method of Applying the Micro-Spectroscopic Test for Blood-Stains, by J. G. Richardson.

THE POPULAR SCIENCE REVIEW. — January. In the Wake of the Challenger, by J. G. Galton. The Cretaceous Flora, by J. Morris.

THE GEOLOGICAL MAGAZINE. — January. Contributions to the Study of Volcanoes, by J. W. Judd. Geology of Ice and Bell Sounds, Spitzbergen, by A. E. Nordenskiöld.

ZEITSCHRIFT FÜR WISSENSCHAFTLICH ZOÖLOGIE. — December 8, 1875. Natural History of the Marine Bryozoa, by W. Repiachoff. Anatomy of *Chætoderma nitidulum*, by L. Graff. On the Order *Gastrotricha*, by H. Ludwig.

ARCHIV FÜR MIKROSKOPISCHE ANATOMIE. — November 20, 1875. On the Tegument of Amphibia, by F. Leydig. On the Anatomy of *Amphioxus lanceolatus*, by P. Langerhans.

ARCHIVES DE ZOÖLOGIE EXPÉRIMENTALE ET GÉNÉRALE. — No. 3, 1875. Researches on the Free Helminths of the Coast of Brittany, by A. Villot. Contributions to a History of the Gregarinæ of Invertebrates of Paris and Roscoff, by A. Schneider. On the Development of Podura, by Oulganin (notice by the editor).

PETERMANN'S GEOGRAPHISCHER MITTHEILUNGEN. — November 10, 1875. Stanley's Exploration of Victoria Nyanza, by E. Behm. Nordenskiöld's New Route by Sea from Europe to Siberia.

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[1] The articles enumerated under this head will be for the most part selected.

THE

MERICAN NATURALIST.

VOL. X. — APRIL, 1876. — NO. 4.

THE AMERICAN ANTELOPE, OR PRONG BUCK.

BY HON. J. D. CATON.

is not possible to give more than a synopsis of the natural istory of the American antelope in the space which may be erly allowed in this journal. It was first made known to the tific world through Lewis and Clark, who found it in 1804 e Upper Missouri, and who at times made it an important t of the chase. On their return they brought with them a men, which was placed in Peale's Museum, at Philadelphia, irst described by Mr. Ord, and named *Antelope Americana.* e years later, in *Journal de Physique*, he gave it a generic ction under the name of *Antilocapra Americana.*

is animal is not a native of the Old World, and is confined ery limited portion of the New; that is to say, the western of the continent, mostly within the temperate zone; and as we shall hereafter see, it avoids forests and high mount- it may not be looked for in many portions of this region. s never found east of the Mississippi River, nor did it even the Missouri River except on its upper part, where it crossed iver in the more arid regions.

habits of our antelope explain why it is so confined in its . Its aliment is strictly herbaceous. It not only rejects ous food, but it has such an aversion to forests that it enters them voluntarily, refusing to be driven into them greatest peril. True, it will cross thin skirts of timber in g from one prairie to another, and the old bucks at certain s, when they seem inclined to avoid the society of their have been known to seclude themselves in the open, park- ades of some districts.

y are exceptionally gregarious in their habits, although mense bands of thousands in which they formerly assem-

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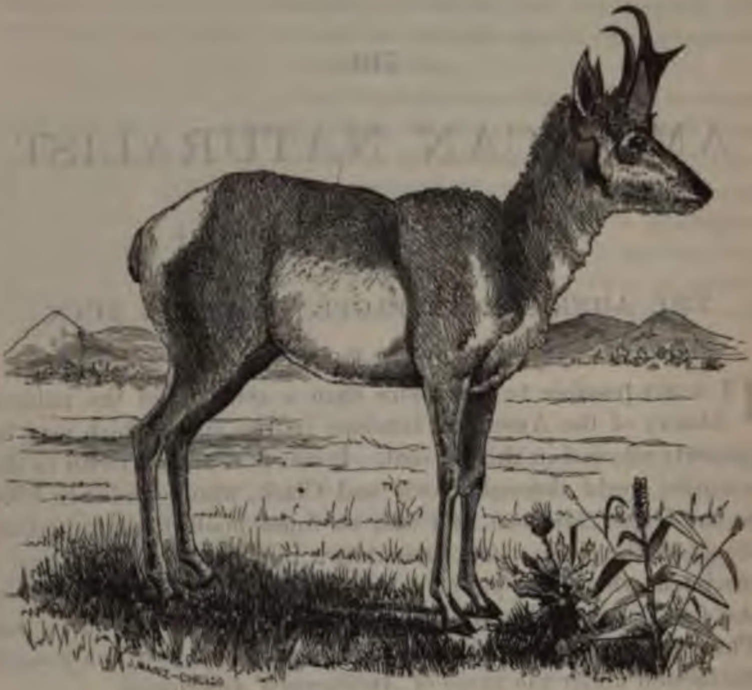
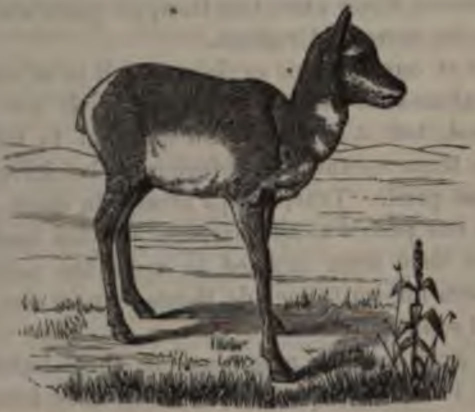


(FIG. 10.) PRONG BUCK.

Adult Male, with a longitudinal section of the right horn, showing the core of the horn.



(FIG. 11.) KID OF THE PRONG BUCK, FOUR MONTHS OLD.

are now broken up by the advancement of civilization, h has absolutely expelled them from those regions where were met with in great numbers a quarter of a century . Then they were most abundant in California, where they times almost literally covered the plains and the foot-hills of the Sierras, and where now a solitary wanderer is rarely l of. The parks and plains in the mountains and east of , and the great table-lands separating the distant ranges, ow most affected by our antelope, for there it finds that dry, lly soil, covered by a scanty but nutritious vegetation, which stes seem to crave and its nature seems to require; there nly the shepherd and the herder are induced to intrude upon clusion and disturb its quiet.

though Richardson objects to the appellation *Americana*, use there may be two species of the genus, it is now settled nd dispute that this animal stands alone, a solitary species distinct genus among ruminants, as we shall presently see, ing so widely in many important particulars that zoölog- aws which have hitherto been considered well settled have abandoned and new ones recognized. *Capra Americana*, was once supposed by some to be a species of the same , is now well established to be a true goat, and no more d to the animal under consideration than is *Ovis montana*, ocky Mountain sheep, and in coat and coloring the latter a much stronger resemblance to our animal than the for-

size, the prong buck (Bartlett) is considerably smaller the ordinary Virginia deer, and less variation among indi- ls is observed than occurs in any of the deer family. A adult male rarely exceeds four feet in length from tip to d three feet in height to the top of the shoulder, while the female is considerably smaller. The hunter never has lty in throwing the largest upon his horse or upon his ler, and walking to camp with him, though if the distance at he gets heavy, no doubt.

form is best understood by reference to the illustration, is taken from life, of a fully adult male standing at perfect The body is short and round, the tail is very short, the is rather short, and is carried very erect. The head is broad and short, and carried well up. The ears are small ect.

hairs of this animal differ from those found on most of the hollow-horned ruminants, and possess the extreme characteristics generally observed in those of the deer. They are hollow except near the roots and extreme points, and are filled with a sort of light pith something like that found in the quill of the turkey or the chicken. These hairs are quite non-elastic and fragile, in this respect resembling more those of the caribou than of any other quadruped. The points of the hairs are solid, and hence firm and tenacious, while the lower parts are moistened by an oily secretion from the skin which makes them the more flexible and less liable to be broken. Hence they are found to be most fragile one quarter or one third of the way down from their points. There is present an under coat of fur during the winter, but this is less abundant than on most of the deer.

On the belly the hairs are more solid and tenacious, and on the legs and face they are quite so. On the top of the neck is a distinct mane, more pronounced on the male, consisting of long, erect, and firm red hairs, which are less abundant towards the body.

The illustration of the young kid will show that it is of the same color as the adult, only the shades become deeper on the older animals. The face is generally black to yellowish-brown, with white cheeks. Below each ear is a dark brown or dull black patch. The neck and upper part of the body are of a yellowish-tawny color, often deepening to a brownish shade. On the lower part of the sides the belly and the inguinal regions are white, which color extends up between the hind legs, uniting with the white patch on the rump. This white area extends up under the neck, where it is broken into transverse bands by the yellowish-tawny of the neck. On many specimens a tawny line extends down the back to and along the upper side of the tail, dividing the whole patch on the rump, while in others this is entirely wanting. The white color on all the parts where it is present is entirely immaculate.

The entire absence of the hind or accessory hoofs found in most other ruminants early attracted attention, and distinguishes the prong buck from both the deer and the antelope, between which it seems to stand. Externally, then, the foot is short and broad, without distinct curvatures, and resembles the foot of the true antelope much more than that of the deer.

A very important feature of this animal is the glandular system which it is found to possess. Until quite recently these glands have not been made a subject of special study. They are per-best described and located by Dr. Murie. All are dermal ds. Two are sub-auricular, and covered by the dark patches dy mentioned. There are two ischiatic glands at the points e hips below the tail, and another pair is found at the hocks, there is an interdigital gland on each foot. Besides the ten ls which may be said to be in pairs, there is a single gland he top of the back at the anterior border of the white patch. e is no lachrymal sinus.

om these glands is emitted an odor more pungent at some ns than at others, and more observable from the old males from the females or the young males; still, it is observable at all times.

e eye is exceptionally large for the size of the animal. It ch larger than that of any of the deer, the ox, or the horse. entire exposed part of the orb is intensely black, so that I never been able by the closest scrutiny to distinguish the from the iris on the living subject. While it is brilliant, it d, soft, and gentle. It is the eye of the antelope gazelle, larger and blacker, as I have often compared them when ing side by side. This animal has been often called the ican gazelle. A female gazelle from Asia, in my grounds, d a disposition to associate and play with a young prong but with no other animal in the grounds. I have seen our pe weep copious tears, when in deep affliction.

domestication this animal loses its wild timidity sooner and completely than any other animal *feræ naturæ* whose docation I have attempted. When taken young it soon ac- the attachment of a child for the human species, and when red adult in a short time becomes so tame that it will take rom the hand and follow one by the hour, walking through ounds. It soon perceives that it has nothing to fear, and eadily bestows its confidence. It is not generally healthy nestication, probably from the humidity of our climate and ant of some alimentary element which it finds in its native . Many are afflicted with scrofula, and some linger and thout any well-defined disease. I have never yet been able p one in my grounds for a single year, but am still contin- ny experiments.

ve never yet heard of an instance where they have bred in tication, although the males especially are excessively sala- in their inclinations; but I have yet to learn of a case of fertility.

They show a degree of intelligence scarcely surpassed by that of the dog, which would, no doubt, be greatly improved by succeeding generations under the influence of domestication, should that be proved possible. One that was in the constant habit of following me soon became disgusted with the elk which chased him, so that whenever he saw me going towards the gate which opened into the elk park, he would place himself in front of me and try to push me back, and then look up imploringly, and if I turned away in another direction would gambol about in the greatest delight. In the wild state, at least, this animal is possessed of inordinate curiosity, by which it is often beguiled within reach of the hunter. In this it resembles the barren-ground caribou, or our small Arctic reindeer.

It is the swiftest of foot of all known quadrupeds, but it cannot continue the race at high speed for a great length of time, although for a few miles or a few minutes its escape seems like the flight of a bird. While it can make astonishing horizontal leaps, even from a standing position, it cannot or will not make high vertical leaps. I do not think that one under any circumstances could be driven over an obstruction a yard in height.

Like that of all the deer tribe, its sight is defective, since it is unable to readily identify objects without the aid of motion. Its senses of smell and hearing are very acute, and on these it largely depends to warn it of the approach of enemies.

The most interesting of all the characteristics of the goat antelope, that which most distinguishes it from all other ruminants, is its horns. These appendages are given to both male and female, but on the latter they are scarcely more than rudimentary till they are fully adult, and even then they are quite insignificant, varying from one to three inches in length at the uttermost. The horn of *Antilocapra* is hollow, like the horn of the goat and the ox, and it is deciduous, like the antler of the deer. When this peculiarity was announced, it was received with entire incredulity by naturalists, and the world of science accepted the truth only after overwhelming evidence had been accumulated.

The first allusion I find to the deciduous character of the horns of this antelope is in Audubon and Bachman's Quadrupeds of North America, ii. 198, where we learn that the hunters at Fort Union told Mr. Audubon that the antelopes shed their horns, but the naturalist "managed to prove the contrary." Again, on page 204, he returns to the subject, but says he was never able to ascertain that they do shed their horns.

Dr. Canfield, of Monterey, California, who lived in the midst
vast flocks of antelope, and had domesticated many of them
l intelligently studied them, in 1848, in a communication to
fessor Baird, of the Smithsonian Institution, announced the
iduous character of their horns quite circumstantially, and gave
ny interesting facts connected with the animal, but the pro-
or considered the announcement so extraordinary that he did
feel justified in publishing the communication. Five years
r Mr. Bartlett, superintendent of the gardens of the Zoölog-
Society of London, himself observed the casting of the horns
n adult male then in the society's gardens, and announced the
to the society in a paper which was published in its Trans-
ons. Since then it has been admitted by naturalists as an
blished fact.

rom the number of these interesting animals which I have
and still have in a state of domestication, my opportunities
observing them have been good, and I have found it the very
ury of study to observe the progress of the growth and the
ing of these horns, and to investigate the mode of growth;
I am sure the reader will bear with me while I give a brief
ription of the process.

he horn of the antelope grows on a permanent process of the
ll which rises upon the supra-orbital arch, so that not an inch
pace intervenes on the adult between the base of the horn
the orb itself. When the male kid is born, a protuberance
be felt where the horn is to grow. This grows with the
and by the time it is six months old, the little horn breaks
ugh the skin, presenting a sharp, hard point. This horn per-
s its growth from the first to the last of January, when it has
ined a length of an inch or less, and is then cast off. The
horn is perfected and cast earlier, and so on till full ma-
ty is attained, when the horn is thrown off in October, though
his strict uniformity must not be expected.

n the adult male the horn is about twelve inches long, and
core in the specimen now before me is little more than five
es long. The horn is laterally compressed. The lower half
out two and one half inches wide and one inch thick, the
rior edge becoming sharper towards the prong. Above the
g it is much less compressed, assuming more a cylindrical
; still it is somewhat flattened to the end. The prong, which
nterior and occurs about midway the length of the horn, is
cely more than an abrupt termination of the anterior part of

the flattened section, where its width is increased to about three and a half inches, terminating in a sharp point; so we may say the prong is one inch in length. But in this different specimens vary considerably.

The horn appears as if constructed of a mass of longitudinal fibres, even presenting a striated appearance, especially the lower part, and is roughened by a great number of small tubercles below the prong to near the base. Many hairs occur on the lower portion of the horn, some of which often remain till the latter is shed. In color the horn is a deep black, except the extreme tip, which is generally a translucent yellowish-white, sometimes for half an inch or more.

If we now confine ourselves to the horn on the adult, we shall the better understand it. Soon after the rut-time is passed, we observe the horn, the shell which envelops the persistent core, lifted from its seat and each day carried up higher and higher, and becoming more and more loose till presently it is thrown off. Then it is revealed to us how this has been done. We look inside the cast-off horn and see that the cavity does not extend above the prong, which is scarcely half-way up the horn. We see that the core was laterally compressed, broad and thin, presenting anteriorly its sharpest edge. The illustration shows the form and extent of this core better than I can describe it in words; and so of the horn itself. I represent the side of the horn cut away so as to show the entire core. As we proceed in our examination we see that when the old horn was thrown off the new horn had already made considerable progress in its growth above the end of the core, and that it was this new growth of horn which had dislocated the old one, completely detached it from the core, and so permitted it to drop off. From the hardened point down to the core, the new horn is warm and slightly elastic and flexible, least so towards the hardened point. To watch the growth of the horn henceforward is exceedingly interesting. It extends in length pretty rapidly, and towards the upper end assumes the posterior curvature as the hardening process, which converts it into true horn, progresses downward. Meanwhile the skin which covered the core, and which was rather sparsely set with long, coarse, lightish-colored hairs, shows no unusual activity. But when the perfected horn reached the top of the core, the upper section of this skin, for an inch perhaps, showed unusual activity, and became thicker, its upper part becoming hard and insensible and finally assuming the consistence of true horn, conforming in

pe to the thin, flat core, only that the new horn projects its
terior edge far beyond the core, thus forming the prong; and so
growth proceeds downward, involving but a limited portion
the skin which covers the core, below which it appears to be
a normal condition and above which is the perfected horn, till
lly it reaches the base of the horn, when the growth may be
sidered perfected. This occurs about the last of July or early
August. The progress of the growth is much slower on the
er part of the horn than it was on the upper part. The
er part of the horn, which envelops the core, is covered more
less with hairs which penetrate it from the skin beneath.
ese we find more abundant as we pass down the horn in our
mination. These at last, however, nearly disappear from the
face, probably by abrasion. As soon as or before the commence-
nt of the rutting season, the horn has completed its growth
has become a perfect weapon, and so continues during that
on, which so excites the males to belligerency. As this
ses by, the growth of the new horn commences at the top of
core and proceeds as before described, lifting the old horn
n its seat and finally throwing it off.

may not occupy the space requisite to describe the pecul-
ies of the growth of the successive horns and of the cores,
le they are growing from the kid to the fully adult, although
show some interesting phenomena. Suffice it to repeat that
first horn of the kid is shed in January; the next year it com
es its growth earlier and is shed in December, and so on each
, the horn being shed a few weeks earlier than was its prede-
or, till when the animal becomes fully adult the horn is cast
after the rutting season is past.

have never had in domestication an adult female, with horns
loped, and cannot say whether they mature and are thrown
t the same times as those of the males.

pparently the skin covering the core of the horn is converted
horn. The microscope alone can reveal the truth of this,
by its aid the whole is made plain. The core of the horn is
covered by the periosteum. Next, and without any interven-
issues, comes the skin, with its proper epidermis. The horns
iously described have their roots in the cellular tissue, or
r stratum of the skin, as we will call it. When sufficiently
nified, the upper or outer part of the skin shows the uneven
arance occasioned by elevations and depressions called papillæ,
observed on other portions of the skin. Upon this uneven

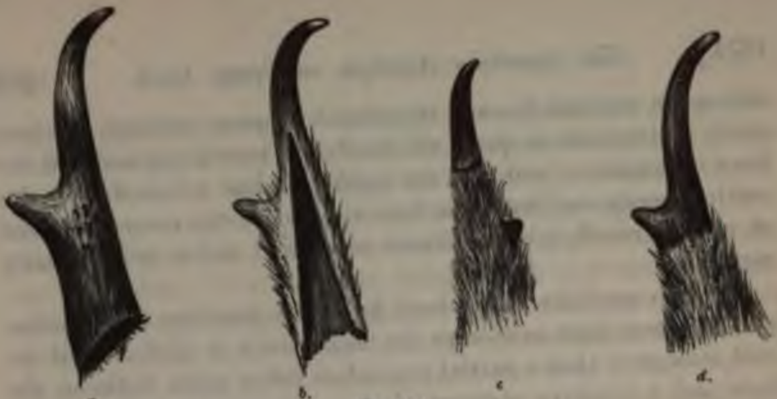
surface rests the epidermis, if we may use that term, where constant activity is ever present. As this epidermis or outer coating of the skin on the human subject, for instance, is constantly wearing away, so must it be constantly renewed by new growths. For this purpose minute cells are constantly being formed upon or next to the papillæ. The new cells, being at the very bottom, necessarily force up their predecessors, which become more and more flattened out in the form of scales. Of these flattened scales the epidermis is formed; as they approach the surface, they become dryer and harder and of a horny nature, even on the most delicate skin, and in that condition these horny scales or flattened cells are worn off by friction. It is these flattened cells which constitute all horns, hoofs, nails, and claws; and so we are not disappointed when we find that the horns of our antelope are composed of these same flattened and dried-up cells. As these cells are forced up and flattened out, they cohere in a mass large enough to form the horn, and in obedience to some law of nature are molded into the proper form. When enough of these flattened and hardened cells have been accumulated and consolidated to constitute the horn at a given place, it cleaves off from the softer inner portion of the cuticle within, leaving a stratum of epidermis covering the corium.

While the mode of growth of this horn so exactly corresponds with that of other and persistent horns, its progress is necessarily widely different. The growth of other horns is very slow and uniform, proceeding from the epidermis at their bases, while this horn, instead of taking a life-time to complete its growth, must be finished in a few months. It is not pushed up and enlarged a little each year by a slow accumulation of these flattened and hardened cells at its base, but it first shoots up with astonishing rapidity from the very top of the core, till the old horn is pushed off and the new one above is far advanced, while over all the rest of the core the cuticle has manifested no unusual activity, but simply a moderate state of vitality is exhibited. When the growth of the horn above the end of the core is completed, the time has arrived for the formation of the new horn below. That part of the epidermis which had been so active and performed such extraordinary work in so short a time relapses into a state of quiet, and a section below has suddenly become aroused to a state of great activity, till it has done its work and completed its horny crust, when in a few days, or weeks at most, it in turn relapses into quiet; and so, as the growth progresses downward, ıccessive sections become stimulated to great activity, do their 'ork, and subside to quiet, till finally the base is reached and the orn is complete; and now the epidermis has a rest during the ıtting season and until the time arrives for the commencement a new growth, which proceeds as before; and so is it annually peated.

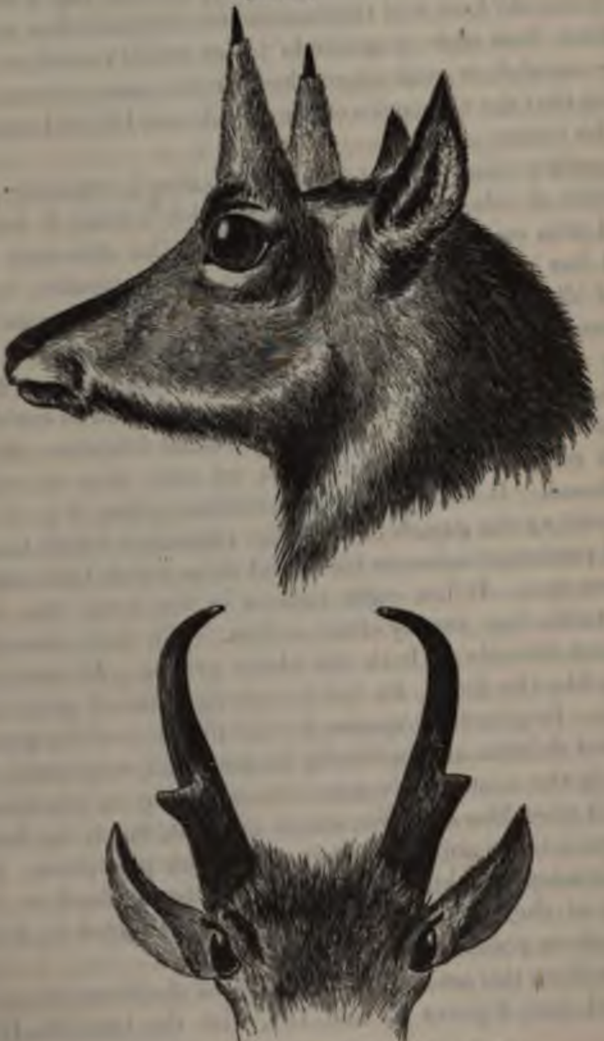
We can partially understand how it is that the lately active ırt becomes quiet so soon as the horn over it is perfected, if we ill remember that a partial separation takes place between the orn and a sensitive stratum of the epidermis, but I cannot so adily explain how it is that successive sections below are awakıed from their state of quietude to an activity nowhere else in ıture equaled or even approached for the same purpose. I can ıly say that the exigencies of the case demand it, and nature supies the means.

Altogether this is a most interesting animal, requiring peculiar nditions of life for its well-being, which confine it to a very nited area on the face of the earth. The discovery of this imal has opened a new chapter to the naturalist, in which me of his preconceived notions must be rudely swept away, and w possibilities in the animal kingdom recognized. It stands litary and alone in the middle space where a void was thought exist, which supposed zoölogical laws had declared could never filled. It supplies a link in the animal kingdom which we ought could not exist, and which we were slow to recognize ıen found. It occupies an intermediate place, if it does not tirely fill up the gap, between those ruminants which have holv and persistent cornuous horns and those which have solid and ciduous ones. It has eight incisors in the lower jaw, and no nine teeth, but twenty-four molars. We find examples of s dental formula in both the above groups. In its skin and ıt it is like the deer. Its eye is most like that of some of the telopes. Its glandular system is most like that of the goat. It the most delicate and particular feeder of all ruminants, while goat is the most promiscuous consumer. In its salacious dissition it resembles and even excels the goat, but is the farthest all from it in its ability to climb rocks and precipices. It has ıny characteristics hitherto supposed to be confined to one or other of the families of ruminants above referred to, while it hibits others peculiar to itself.

Since writing this article I have examined the illustrations here produced (see Figures 12 and 13), with the late Mr. Hays's



(Fig. 12.)



(Fig. 13.) THE PRONG BUCK. (*After* Hays.)

Fig. 12.— a. The horn just shed. *b.* A longitudinal section, showing the manner in which the hairs pass through the horn. *c.* The appearance of the horn in January. *d.* Its appearance in April.

ticle on the growth of the horns of the prong buck, in the ATURALIST, volume ii., page 131, and find some differences beveen his observations and mine, from which we may infer the ant of exact uniformity not only in the structure but in the ogress of the growth of the horn. The section of the horn own in Figure 12 shows a core differing in both form and exnt from any I have seen. I have never met one where the re extended above the prong.

ARE POTATO BUGS POISONOUS?[1]

BY AUG. R. GROTE AND ADOLPH KAYSER.

STATEMENT of the poisoning qualities of the *Doryphora decemlineata*, or potato bug, has repeatedly been made in pubprints, and notably in the Seventh Report on the Insects of issouri by Professor C. V. Riley. It is claimed that after coming contact with the bugs, or inhaling the steam or smoke produced boiling or burning them, persons have exhibited various sympns of cutaneous or nervous disease.

To investigate the matter, a quantity of the bugs collected from lds near Buffalo, where no arsenic had been used, was submit- to distillation with salt water, so as to allow of an increased nperature. Under this process, about four ounces of liquid were cured from one quart measure of the insects. This liquid was fectly clear, and emitted a highly offensive smell; it proved alkaline reaction on account of the presence of a certain quan- of free ammonia and carbonate of ammonia.

Again, an equal quantity of the bugs was used to prepare a cture made as follows: Absolute and chemically pure alcohol condensed upon the live bugs; after a digestion of twentyr hours the alcohol was evaporated at a gentle heat. The ture so obtained had a decidedly acid reaction, was brown in or, and was not disagreeable in smell.

To ascertain the effect on the animal system of the liquid and tincture above described, a number of frogs were procured for experiment. About one half cubic centimetre of the liquid the tincture each was introduced separately into the stomach. ther the liquid nor the tincture produced any apparent effects. vivacity of the frogs so treated continued unimpaired, nothstanding the complete retention of the doses. Again, two fresh frogs were submitted to a hypodermic injection of the liquid and the tincture, in the hind legs, by means of an ordinary hypodermic syringe. The injection of the distilled liquid was unattended by injurious results. A slight disinclination, at first, to use the hind limbs was shown also in the case of another frog, which was treated hypodermically with pure water to check the results obtained.

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[1] Read at the Detroit Meeting of the American Association for the Advancement ience, 1875.

The injection of the tincture, however, proved fatal to the subject. A few moments after the injection the leg operated upon seemed to become paralyzed, and the heart stopped beating within thirty minutes afterwards, by which time the other two hypodermically treated seemed to have completely overcome the effects of the operation.

The tincture, although highly concentrated, contained but a small quantity of animal acids, which, when saturated with bases of potassa and soda, formed deliquescent hexagonal crystals, visible under the microscope, but insufficient in quantity to analyze. It is known that such acids are very active in their effects upon the animal system. The bite of a flea or of a bedbug is attended by an introduction of acids which produce a swelling by the coagulation of the albuminous fluids of the body. The rapid coagulation of milk was shown by the experiment of introducing a few drops of the tincture above described, during the present experiments. In the case of the insects above mentioned, especial organs are occupied with the secretion of the acids which serve the insect economy by coagulating those parts of the blood of the victim which may not be useful for food. No such organs have been noticed in the potato bug. The presence of the acid leads us to conjecture as to the origin of such organs, while they have apparently not become developed in the potato bug. The acids being found to be present in such small quantity, the conclusion is unavoidable, in the light of the present experiments, that the bugs are *not* poisonous.

Rather does it seem likely that the published statements to the contrary were based on erroneous observations, while it is extremely probable that certain of the more aggravated and circumstantially detailed cases of poisoning are due to the effects of arsenic (Paris green and arsenious acid), which is now profusely used for the extermination of the bugs. Many metallic salts will produce cutaneous irritation; when arsenic is sublimed by heat, the inhaled fumes will produce nervous disorder; the effects of Paris green may have been mistaken for those of the potato

gs. It is credible, moreover, that when larger amounts of the
gs are thrown into a fire to destroy them, even when not con-
ning any arsenic, an incomplete combustion might take place,
which case carbonous oxide (CO) would be produced, which
uld certainly bring about the evil effects complained of. It
y also be remarked that previous to the advent of the potato
; the potato plant itself had not been so freely handled as
ely; an inquiry as to the effects of the entrance of the minute
rs from the leaf into the skin, and also into the properties of
juice of the plant, might show cause for some symptoms com-
ined of.

At this time, when the use of arsenious acid is forbidden in
rmany in the manufacture of aniline colors, on account of its
l effects on animal organisms, it may not be thought im-
per to call the attention of the people of our country to the
sent use of arsenic in the culture of so universal a food plant
he potato.

THE LITTLE MISSOURI "BAD LANDS."

BY J. A. ALLEN.

Western Dakota are what are termed the Little Missouri
"Bad Lands," a region as picturesque and strange as the
gination can well conceive. As we leave the Missouri River at
t Abraham Lincoln, the present western terminus of the
thern Pacific Railroad, the journey to these "Bad Lands"
nainly by the so-called Sully's Trail, which runs nearly due
tward between the 46th and 47th parallels. The three hun-
l miles of treeless prairies that lie between the Missouri and
le Missouri rivers present us with nothing of remarkable
rest. Gradually, as we advance westward, the grass becomes
tier and the cacti and sage bushes more abundant, evincing
increasing aridity of the climate. Isolated, conical mounds
buttes," occasionally of considerable height, are seen at long
rvals, and serve as important landmarks. The streams are
and small, the most of them dwindling towards the end of
nmer to a series of detached, brackish pools. Along the larger
hem we meet here and there with little clumps of trees, or,
e rarely, with continuous narrow belts of timber, consisting
nly of box-elder and cotton-wood, with a sprinkling of elm;
ccasionally they are made up almost entirely of oak. These
groves, sometimes a day's journey apart, constitute the

only trees met with, — little wooded oases in a vast expanse of rolling, grassy prairie. In crossing these prairies we miss, even in June, when the vegetation is in its greatest freshness, the variety and profusion of flowers that give to the more southern prairies the aspect of a vast flower-garden, — the patches of pink, orange, yellow, and other bright tints produced by the social grouping of the prevailing species, which impart their own hues to broad areas of the landscape, as do often the buttercups and daisies to New England hill-sides. Most conspicuous on the Dakota prairies, west of the Missouri, are the little prairie roses (*Rosa blanda* Ait.), which fill the air with their delicate perfume, and seem often to almost cover the ground in their abundance. These gems of the prairie in a measure atone for the absence of a greater variety of showy flowering plants.

Bird life is abundant over these prairies, they being everywhere enlivened by the few peculiar kinds, such as larks, buntings, and sparrows, that so eminently characterize the Plains. Among them, however, the ornithologist detects with delight both the Missouri skylark (*Neocorys Spraguei* Scl.) and Baird's bunting (*Centronyx Bairdii* Bd.), species which until a few years since were among the least known of the birds of the continent. Few mammals attract our attention, the prong horn, or so-called "antelope" (*Antilocapra Americana* Ord), being the chief, which, while notable for its grace and beauty, is also the principal game animal of this portion of the Plains; the American bison, or "buffalo," which existed here but a few years since, and whose trails still remain, having now wholly disappeared from the region east of the Yellowstone. The "prairie-dog towns" are somewhat frequent, their little occupants being ever objects of interest; occasionally the prairie hare (*Lepus campestris* Bach.), or jackass rabbit, as more commonly called, surprised by our approach, scampers away in all possible haste, his immense ears and very long legs giving him the appearance of being much larger than he really is.

After days of pleasant journeying amid such scenes as these, we find ourselves upon the border of the "Bad Lands," to the exploration of which we have long looked forward with so much interest. Though they are but a few miles distant, there is nothing as yet to indicate their proximity; we see before us only the same low ridge that in prairie landscapes seems ever to bound the horizon. Reaching the crest of this low ridge, however, we have before us, instead of another similar swell, one of

strangest vistas the continent affords. We look down upon
road valley studded with detached, nearly bare, conical, pyram-
l, and rectangular mounds, one hundred to several hundred
t in height, and a few yards to many hundred yards in length.
are similarly capped with a stratum of bright red, indurated
, which on closer examination proves to have been metamor-
sed by heat, and to be mixed with cinders and other mineral
stances that seem to have had a volcanic origin. The mounds
mselves are made up of variegated shales, horizontally dis-
ed, which, seen in section in the nearly vertical sides of the
nds, appear as parallel bands of yellow, brown, green, gray,
k, and other tints, surmounted with red. This strange pan-
na extends for many miles, and as we gaze upon it for the
time we soon cease to wonder that General Sully, in his
ch through this region in 1864, should have likened it to "*hell*
the fires out," as he is currently reported to have done.

he trail we have chosen fortunately leads us through the
heart of this interesting country, so that the experiences of
ngle day even would be sufficient to give us considerable
liarity with the varied phenomena of a locality that may be
n as a fair illustration of the remarkable topography of an
nsive region. By a difficult and winding descent we reach
valley of Davis Creek, through which we are to find our way
e Little Missouri. Our interest in our surroundings con-
ly increases, as at every step some new feature, noticeable
ts picturesque effect or as illustrative of some geological
, attracts our attention. The mounds and ridges increase in
t, their rounded summits still capped with bright pink
, and almost verdureless. Red bands are also seen at inter-
in the sides of these mounds, these bands being composed of
ame baked, reddened clay as that covering the summits,
generally a thin layer of scoriaceous material at the bottom
ch red band. Although traces of fire are so evident, the
that has given the country its present broken character
een the gentle action of water. The strata everywhere pre-
their almost perfectly horizontal position, these buttes and
, narrow ridges being but the remains of strata that once
the country to a higher level than even the tops of the
st buttes now standing. By the slow process of aqueous
n have the soft strata of sands and clays been removed,
he country scored to the depth of hundreds of feet.

t other forces have been at work. Heat of great intensity, and from an unusual source, has also acted here on a grand scale, but as a preserving rather than as a destroying agent. Beds of lignite, a few inches to several feet in thickness, occur interstratified with the deposits of sand and clay. The deep, sharp gullies formed by the action of water have exposed these beds of lignite for long distances. This exposure to atmospheric influences seems to have in some way produced spontaneous combustion of the lignite, for there is abundant evidence that some of the igneous action about to be described occurred before the close of the terrace epoch. Whatever may have caused the coal beds to take fire, the fact remains that for long ages their destruction has been going on, and even still continues, producing geological results of a most interesting and important character. When once well ignited they seem to burn for long periods, the fires penetrating far into the interior of the hills, extending at times till all the coal seams over very large areas are consumed. At the present time these fires are known to sometimes originate from the prairie fires, which occasionally sweep over these lignite exposures and ignite the coal. But a large proportion of the beds that have been destroyed appear to have been so situated that prairie fires could not have reached them, the exposures being about midway up the bare, nearly vertical faces of very high bluffs. Wherever the lignite beds have been burned, their former position can be easily detected by the bright red bands of the hardened overlying clays and sands which have been metamorphosed by their combustion, these red bands being often traceable by their color for long distances, occurring at the same level in butte after butte.

The burning of such large masses of lignite must of course, especially when the beds have considerable thickness, produce an intense heat; yet the metamorphism here seen seems sometimes to be on too grand a scale to be the result of so limited a cause. The thickness of the strata more or less changed in texture and color by the heat varies, of course, with the thickness of the seam of lignite the burning of which was the source of the metamorphic action, and hence ranges from a few feet to twenty or thirty, and occasionally to upwards of fifty! In many cases the heat was sufficient to partly or wholly fuse the shales immediately in contact with the burning lignite, giving them a semi-vitreous or porcelaneous texture. At the bottom of the series of metamorphosed beds we have usually a layer of cinders and clinkers, which occupies the position of the former lignite bed itself. This

ver is generally of a whitish or grayish color, and is made up
rgely of hard, semi-vitreous, vesicular material, the larger inter-
ces of which are filled with ashy or earthy matter; while occa-
nally portions are so soft as to be easily crumbled in the hand,
crushed under the foot. Indeed, it is not much unlike the re-
uum left in our grates from the burning of common coal.

The material next above this often shows signs of having been
a semi-molten or at least plastic condition, and generally pre-
its a great variety of tints, as olive, drab, yellow, gray, white,
wn of various shades, purple, and even black. The purple
l olive tints are quite frequent; the other colors often occur in
rrow zones or mere lines, producing a very beautiful effect.
e texture varies from a dense, compact, jaspery character to
t so porous and vesicular that the mass will float upon water,
h every degree of porosity between these extremes. This
iegated layer is usually but a few inches in thickness, and is
rather local occurrence, as is also the scoriaceous or vesicular
tter, neither appearing except where the heat has been very
ense. The scoriaceous material also varies greatly in color,
ng usually black, but sometimes grayish, while it also occurs
every shade of red, from dark reddish-brown to bright car-
ne. These materials always pass gradually into the overlying
dened, baked clays, which, as previously stated, may vary in
kness from a few feet to twenty or more, and which, from
ir great thickness, bright color, and wide distribution, form
of the characteristic features of the region we are considering.
color of these beds is that of bright red bricks, and where
material has been thinly scattered about by the gradual dem-
ion of buttes once covered by it, as sometimes happens, the
mblance of the locality to an old, long-abandoned brickyard is
striking. These hardened clays still retain the abundant
ressions of plant-remains, but they are generally too frag-
tary to be of much value as specimens. A few quite well-
erved casts of the leaves of exogenous plants occur, but the
etable relics consist mainly of the imprints of broad-leaved
ses and sedges, which seem to have in places nearly filled the
s. Heavy clay deposits almost always immediately overlie
beds of lignite, and when they are very heavy, or the seam
ignite is very thin, the metamorphism scarcely extends be-
l the stratum of clay; usually, however, it affects the stratum
nd that rests upon the clay, sometimes converting it into a
coarse-grained, rather soft sandstone, hand-specimens of

which are scarcely, if at all, distinguishable from the red sandstone of the Connecticut Valley. The metamorphism gradually ceases in passing upward, as respects both color and hardness, till the influence of the heat wholly disappears. The color of these metamorphosed shales thus fades from intense red, or even black, through light brick-red to pale red and pale reddish-yellow; whilst the texture varies from crumbling scoria and slag, through rock of a trappean texture and conchoidal fracture, to finely fissured baked clay and sandstone, and finally to shales but slightly hardened and almost unchanged in color.

The beds thus altered often present interesting features of structure, the indurated clays being extremely fissile, breaking up into thin, small, irregularly shaped splinters and fragments, which possess a clear, metallic resonance; the sandstones occasionally present a prismatic structure, with the planes of cleavage oblique to those of stratification, the mass breaking into five or six sided prisms, half an inch to an inch or two in diameter, and one or two to even two and a half feet in length, almost slender enough and long enough for walking-sticks!

As already intimated, the beds of lignite vary greatly in thickness, from a few inches to five or six feet, and even more,[1] with corresponding variations in the amount of metamorphism produced by their combustion. In the burning of the heavier of these beds not only is an immense amount of heat generated, but vapors are formed which, in escaping, have also left their interesting records. These consist of jagged, chimney-like mounds of breccia that still crown many of the buttes and ridges, the softer materials that surrounded them having been worn away by denuding agencies, leaving them as striking and picturesque features of the landscape. These mounds have sometimes the form of short, thick columns, being circular, a foot or two in diameter and a few feet high; at other times they are ten or twelve feet in diameter and of about the same height, while they not unfrequently assume the form of low, narrow, ragged walls of highly altered rock, the material of all these erupted mounds presenting the features of a true volcanic breccia. The matter composing these chimneys was mostly forced up through small orifices or narrow fissures, ile in a plastic or half-molten condition. At these points the t was so great that the sands and clays through which the ures extended became thoroughly melted, leaving the walls these fissures with glazed surfaces, vitrifying them to depths ying from half an inch to several inches. In some instances melted matter ran down while in a viscous state, solidifying pendant, rounded masses; in other cases it was squeezed out ough lateral cracks in the walls of the main fissures, congeal- in similar botryoidal forms. Again, masses are seen in these mney-like mounds that seem to have been twisted and folded en in a viscous state, the surface still retaining its waxy lustre.

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[1] Near the mouth of Powder River I met with two beds, one five and the other eight feet thick, separated by only about three feet of shale. On Custer's Creek I also met with a heavy bed, which varied in thickness at different exposures from six to ten feet. A considerable amount of metamorphic action may readily be conceived as resulting from the combustion of such large masses of lignite, some of which has nearly the heat-producing power of cannel coal.

n connection with the formation of these fissures and mounds re were slight disturbances of the adjoining strata, affecting etimes an area of only a few feet in diameter, and rarely ex- ding over many yards. Occasionally, however, the fissures ended for considerable distances, accompanied by the usual nomena of intense igneous action already noticed, with a dis- bance of the strata for several yards on either side of the fis- , where many feet in thickness were lifted and still remain hly inclined. We have here, in fact, a series of volcanic fs, or *volcanoes in miniature*, having their seats of action in the ning coal-seam, ten, fifteen, or perhaps fifty feet below. In- d, some of these disturbed areas present a very broken and anic aspect, and a geologist suddenly transported to one of e localities would feel at first that he must be in the midst of uly volcanic district. He would find that from the tops of e apparently volcanic ridges blocks of scoriaceous material, ering in no respect from real volcanic products, have rolled n into the adjoining valleys, and lie scattered in masses vary- from a foot in diameter to those of several tons' weight. The ed masses of rock crowning the higher points of the ridges, ruined battlements, with the adjoining chasm-like ravines, d with highly metamorphosed rock, do combine, in fact, to ent quite a disturbed and chaotic scene; yet a careful ex- nation of even these localities shows that the strata are ywhere horizontal, save at such few limited areas as those dy noticed. We find here, as usual, the horizontal beds of ers underlying the metamorphosed strata, differing from e of other localities only in their greater thickness, and point- out most conclusively the origin and cause of these local dis- ions and former intense igneous action. That the burning e lignite beds is really competent to produce all these effects we have the abundant stratigraphical proof afforded by this whole region, and the further testimony of trustworthy eye-witnesses, who have seen the beds of lignite on fire with the same phenomena resulting as those above described.

The effect of this metamorphic action, when we consider its cause, upon the general topographical and geological features of the region under consideration, is wonderful almost beyond conception. Wherever the country is deeply scored by ravines usually several of these red bands of metamorphosed shales occur, separated by fifty to one hundred and fifty or more feet of unaltered clays and sands, and, running horizontally and parallel to each other, are seen for many miles, passing at the same elevation through butte after butte and ridge after ridge. The highest points are invariably capped with this hardened material, and hence all rise to about the same level over an area of many square miles. Generally there are several sets of these elevations, differing only in size and height, the hardened bands that cap the smaller and lower appearing at the same elevation in the sides of the larger and higher, which are capped with portions of higher beds that have nearly disappeared. The indurated beds thus in a great measure determine the height and form of these remnants of strata which once filled the valleys to a height considerably above the tops of the highest points now left, and serve as a great check upon the surprisingly rapid erosion now going on, and which is every year removing vast quantities of the easily yielding strata.

The extent of the influence of this igneous action upon the general aspect and character of the country is perhaps most impressively seen from elevations that overlook considerable areas of these strange "Bad Lands;" the scene of course varying greatly in its topographical details with every change in the position from which it is viewed. From a high point on the western bank of the Little Missouri, nearly opposite the mouth of Davis Creek, the view is that of a vast expanse of verdureless mounds and walls of naked rock, interspersed here and there with little grassy plateaux, and crossed by the green valley of Davis Creek, with its scanty fringe of low trees. Bright red is the prevailing color of the landscape, but in the nearer ridges the bands of yellowish-brown, dark-brown, and grayish shades are also distinguishable. The surface of the country is everywhere deeply scored, some of the higher points being two hundred and fifty to three hundred feet above the bed of the Little Missouri, and the

e catches little else than the bare, more or less metamorphosed
ales. Each hardened band forming a considerable check to
e eroding forces, the country presents a series of narrow ter-
ces; these, being covered with a scanty growth of vegetation,
rm little plats and strips of green that pleasantly relieve the
herwise unbroken expanse of barrenness. Such a scene of wild-
ss and desolation seems like a glimpse, as it were, of a half-
rmed world, unfit as yet for the habitation of man or for his
es.

A more extensive view of the Little Missouri "Bad Lands" is
tainable from the Sentinel Buttes, two high points situated
the western border of this remarkable region, and reaching an
vation of about six hundred feet above the Little Missouri.
e horizontal position of the strata composing these elevations
ws what a vast amount of material has been removed from the
rounding region by the slow action of denuding forces. The
ntry presents, as we look eastward from these buttes, an al-
st continuous expanse of low, red-capped ridges and buttes, the
vailing red color being relieved only by bands of yellowish-
wn and gray tints formed by the unaltered shales exposed in
deeply cut ravines. In this direction the view consists almost
olly of bad lands, — a vast stretch of undulating, verdureless
surface, extending as far as the eye can reach, only the naked
sts of the distant, red-capped buttes and ridges being visi-
. It is a scene not easily forgotten, so utterly barren, and yet
wild and picturesque. Its desolateness is doubtless greatly
ghtened by the contrast of green, rolling prairie which meets
eye when turned in the opposite direction. In looking north-
rd or southward we have on the one hand a beautiful prairie
dscape, broken only here and there by a low, red-capped
te or sharp ridge, while on the other is a boundless expanse
naked red mounds and ridges, — billows, as it were, of a fiery
, — the transition from the one to the other being abrupt and
ngly marked.

We have here before us but a portion of one of the numerous
ts of these peculiar bad lands that occupy vast areas of East-
Dakota and Western Montana. The Little Missouri "Bad
nds," with a breadth varying from twenty to thirty miles, ex-
d for hundreds of miles along the stream from which they de-
their name. Other equally remarkable areas appear at in-
vals along the Missouri, from the vicinity of Fort Berthold
rly to the Judith River, or for a distance of fully five hundred

miles. Another immense area occurs along the Yellowstone, extending from its mouth nearly up to the Big Horn River, or for several hundred miles, as well as for long distances up its lower tributaries. The valleys of the Rosebud, Tongue, and Powder rivers are, indeed, among the most noteworthy localities of these metamorphic phenomena, the hills being sometimes reddened as far as the eye can reach by the burning out of the lignite beds. This metamorphism is, in short, almost coextensive with the lignitic tertiary formation of the Upper Missouri, which occupies an area some five hundred miles in length by about three hundred and fifty in breadth, extending from near the 100th to about the 108th meridian, and from the vicinity of the 43d to far beyond the 49th parallel. Within this region, however, are occasional districts where this metamorphism occurs only in the higher, scattered buttes, the great areas of this disturbance and change being the borders of the principal water-courses, as the Missouri and its southern tributaries between the above-named points, including the Yellowstone and its eastern affluents.

JUMPING SEEDS AND GALLS.

AT a late meeting of the Academy of Sciences of St. Louis, Mr. C. V. Riley exhibited certain seeds which possessed a hidden power of jumping and moving about on the table. He stated that he had recently received them from Mr. G. W. Barnes, of San Diego, Cal., and that they were generally known by the name of "Mexican jumping seeds." They are probably derived from a tricoccous euphorbiaceous plant. Each of the seeds measures about one third of an inch in length, and has two flat sides, meeting at an obtuse angle, and a third broader, convex side, with a medial carina. If cut open, each is found to contain a single fat, whitish worm, which has eaten all the contents of the seed and lined the shell with a delicate carpet of silk. The worm very closely resembles the common apple worm (*Carpocapsa pomonella*), and indeed is very closely related, the insect being known to science as *Carpocapsa saltitans*. It was first recorded by Westwood in the Proceedings of the Ashmolean Society of Oxford, in 1857 (iii. 137, 138), and repeatedly referred to under the name of *Carpocapsa Dehaisiana* in the Annales of the French Entomological Society for 1859.

The egg of the moth is doubtless laid on the young pod, which contains the three angular seeds, and the worm gnaws into the sucent seed, which, in after growth, closes up the minute hole of rance, just as in the case of the common pea weevil (*Bruchus* i). Toward the month of February the larva eats a circular e through the hard shell of its habitation, and then closes it in with a little plug of silk so admirably adjusted that the ure moth, which will have no jaws to cut with, may escape n its prison. A slight cocoon is then spun within the seed, h a passage-way leading to the circular door; and the hith- restless larva assumes the quiescent pupa state. Shortly rwards the pupa works to the door, pushes it open, and the e moth escapes. When ripe, the shell is very light, and, as worm occupies but about one sixth the inclosed space, the htest motion will cause the seed to rock from one of the flat s to the other. But the seed is often made to jerk and jump, , though this has been denied by many authors, Mr. Riley had abundant proof of the fact, and had seen the seed jerked ral lines forward at a bound, and raised a line or more from surface on which it rested. If the seed be cut, the worm soon cover up the hole with a transparent membrane of silk; if two of the opposite angles be cut, the movements of the n can then be seen, if the seed be held against the light. It becomes evident that the jerking motion is conveyed by the n holding fast to the silken lining by its anal and four hind minal prolegs, which have very strong hooks, and then draw- back the head and fore-body and tapping the wall of its cell the head, sometimes thrown from side to side, but more brought directly down, as in the motion of a woodpecker's when tapping for insects. In drawing back the fore-body thoracic part swells, and the horny thoracic legs are with- n, so as to assist the jaws in receiving the shock of the tap, h is very vigorous, and often given at the rate of two a sec- and for twenty or more times without interruption. It is rkable that this, of all the numerous seed-inhabiting Lepi- erous larvæ, should possess so curious a habit. The seed move for several months, because, as with most Tortricid- arvæ, this one remains a long time in the larva state after ng to its growth and before pupating.

r. Barnes gives the following account of the plant, received gh Captain Polhamus, of Yuma, A. T. It seems to be l both *Yerba de flecha* and *Colliguaja* by the Mexicans: ow-weed (*Yerba de flecha*). This is the name the shrub that produces the triangular seeds that during six or eight months have a continual jumping movement. The shrub is small, from four to six feet in height, branchy, and in the months of June and July yields the seeds, a pod containing from three to five seeds. These seeds have each a little worm inside. The leaf of the plant is very similar to that of the 'garambullo,' the only difference being in the size, this being a little larger. It is half an inch in length and a quarter of an inch in width, a little more or less. The bark of the shrub is ash-colored, and the leaf is perfectly green during all the seasons. By merely stirring coffee or any drink with a small branch of it, it acts as an active cathartic. Taken in large doses it is an active poison, speedily causing death unless counteracted by an antidote."

Mr. Riley stated that the seed of *Tamariscus* was known to be moved by a Coleopterous larva (*Nanodes tamarisci*) that fed within it; and he concluded by describing and exhibiting a still more wonderful jumping property in a seed-like body which may be observed in our own woods. It is a little spherical, seed-like gall produced in large numbers on the under side of the post and other oaks of the white-oak group. This gall drops in large quantities to the ground, and the insect within can make it bound twenty times its own length, the ground under an infested tree being sometimes fairly alive with the mysterious moving bodies. The noise made often resembles the pattering of rain. The motion is imparted by the insect in the pupa and not in the larva state. Mr. Riley presented a description of the gall, which may be known by the name of *Quercus saltatorius*, the black fly which issues from it having been described as *Cynips saltatorius* by Mr. H. Edwards, of San Francisco.

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THE PROGRESS OF DISCOVERY OF THE LAWS OF EVOLUTION.

AT a recent meeting of the Academy of Natural Sciences of Philadelphia, Professor Cope made some remarks on the progress of discovery of the laws of evolution, of which the following is a synopsis: —

He remarked that while Darwin has been its prominent advocate within the last few years, it was first presented to the scientific world in a rational form by Lamarck, of Paris, at the commencement of the present century. Owing to the adverse influence of Cuvier, the doctrine remained dormant for half a century, and Darwin resuscitated it, making important additions at

same time. Thus Lamarck found the variations of species
be primary evidence of evolution by descent. Darwin enun-
ted the law of "natural selection" as a result of the struggle
existence, in accordance with which "the fittest only survive."
is law, now generally accepted, is Darwin's principal contri-
ion to the doctrine. It, however, has a secondary position in
tion to the *origin* of variation, which Lamarck saw, but did
account for, and which Darwin has to assume in order to
e materials from which a "natural selection" can be made.

The relations exhibited by fully grown animals and plants
h transitional or embryonic stages of other animals and plants
attracted the attention of anatomists at the time of Lamarck.
ne naturalists deduced from this now universally observed
nomenon that the lower types of animals were merely re-
ssed conditions of the higher, or, in other words, were embry-
stages become permanent. But the resemblance does not
ally extend to the entire organism, and the parallels are so
mplete that this view of the matter was clearly defective, and
not constitute an explanation. Some embryologists, as Lere-
llet and Agassiz, asserted that no argument for a doctrine of
ent could be drawn from such facts.

he speaker, not adopting either view, made a full investigation
the later embryonic stages, chiefly of the skeleton of the batra-
, in 1865, and Professor Hyatt, of Salem, Mass., at the same
made similar studies in the development of the ammonites
nautili. The results, as bearing on the doctrine of evolu-
, were published in 1869 in a paper entitled The Origin of
era. (Proceedings of the Philadelphia Academy of Natural
nces.) The relation usually observed between adult types
transitional stages was there termed *inexact parallelism.*
as then pointed out that the most nearly related forms of
nals do present a relation of repression and advance, or of
nanent embryonic and adult type, leaving no doubt that the
descended from the other. This relation was termed *exact*
llelism. It was also shown that if the embryonic form were
parent, the advanced descendant was produced by an in-
sed rate of growth, which phenomenon was called *accelera-*
; but that if the embryonic type were the offspring, then its
re to attain to the condition of the parent is due to the super-
ion of a slower rate of growth. To this phenomenon the
retardation was applied. It was then shown that the inexact
llelism is the result of unequal acceleration or retardation;

that is, acceleration affecting one organ or part more than another, thus disturbing the combination of characters which is necessary for the state of *exact parallelism* between the perfect stage of one animal and the transitional stages of another. Moreover, acceleration implies constant addition to the parts of an animal, while retardation implies continual subtraction from its characters, or atrophy. The speaker had also shown (Method of Creation, 1871) that the additions appeared either as *exact repetitions* of preëxistent parts, or as *modified repetitions*, the former resulting in simple, the latter in complex organisms.

Professor Haeckel, of Jena, has added the key-stone to the doctrine of evolution in his gastræa theory. Prior to this generalization, it had been impossible to determine the true relation existing between the four types of embryonic growth, or to speak otherwise than to the effect that they are inherently distinct from each other. But Haeckel has happily determined the existence of identical stages of growth or segmentation in all the types of eggs, the last of which is the gastrula, and beyond which the identity ceases. Not that the four types of gastrula are without difference, but this difference may be accounted for on plain principles. In 1874, Haeckel, in his Anthropogenie, recognized the importance of the irregularity of time of appearance of the different characters of animals during the period of growth, as affecting their permanent structure. While maintaining the view that the low forms represent the transitional stages of the higher, he proceeds to account for the want of exact correspondence exhibited by them at the present time by reference to this principle. He believes that the relation of parent and descendant has been concealed and changed by subsequent modification of the order of appearance of characters in growth. To the original, simple descent, he applies the term *palingenesis ;* to the modified or later growth, *cœnogenesis.* The causes of the change from palingenesis to cœnogenesis he regards as three, namely, acceleration, retardation, and heterotopy.

It is clear that the two types of growth distinguished by Professor Haeckel are those which had been pointed out by the speaker, in The Origin of Genera, as producing the relations of exact and inexact parallelism, and that his explanation of the origin of the latter relation by acceleration or retardation is the same as that of the latter essay. The importance which Haeckel attaches to the subject was a source of gratification to the speaker, as it was a similar impression that led to the publication he Origin of Genera in 1869.

It remains to observe that the phenomena of exact parallelism,
palingenesis, are quite as necessarily accounted for on the prin-
le of acceleration or retardation as are those of inexact par-
elism, or cœnogenesis. Were all parts of the organism accel-
ted or retarded at a like rate, the relation of exact parallelism
uld never be disturbed, while the inexactitude of the par-
lism will depend on the number of variations in the rate of
wth of different organs of the individual, with additions in-
duced from time to time. Hence it may be laid down that
chronous acceleration or retardation produces exact parallel-
, and heterochronous acceleration or retardation produces in-
ct parallelism.

n conclusion, it may be added that acceleration of the segmen-
on of the protoplasma or animal portion of the primordial
, or retardation of segmentation of the deutoplasma or vege-
ve half of the egg, or both, or the same relation between the
wth of the circumference and centre of the egg, has given rise
he four types which the segmentation now presents. This
lysis of the laws of evolution was tabulated as follows: —

		Exact parallelism produced by *palingenesis*, which is synchronous	*Inexact parallelism* produced by *cœnogenesis*, which is heterochronous
cceleration, proceeds by	Exact repetition.	•	•
	Modified repetition.	•	•
	Heterotopy.	•	•
etardation, proceeds by	Exact atrophy.	•	•
	Modified atrophy.	•	•

FLORA OF GUADALUPE ISLAND, LOWER CALI-FORNIA.[1]

BY SERENO WATSON.

E island of Guadalupe is in latitude twenty-nine degrees
north, about one hundred miles from the coast of Lower
fornia, and two hundred and thirty west of south from the
of San Diego, which is near the southern line of California.
twenty-six miles in length in a north and south direction,
an average breadth of ten miles, and is traversed by a
tain ridge, the central peak (Mount Augusta) having an

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[1] tract from the Proceedings of the American Academy of Arts and Sciences,
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elevation of 3900 feet above the level of the sea. From this point the nearest main-land is visible. The sides of the ridge are exceedingly rough and broken, cut up by numerous deep and rocky cañons, and even the more level surfaces are described as usually covered by rocks of every size and form. The rocks are volcanic, and several extinct craters still exist.

The island lies within the great ocean current which flows from the peninsula of Alaska down our western coast, the continuation of what is known as the Japanese Gulf-Stream, and in the zone of the northwest trade-winds. Fogs are very prevalent, especially in the winter months (from November to February), when they are driven by the winds over the crest of the island, covering all the northern end and filling the upper portions of the cañons, while the lower cañons and the southern extremity of the island remain clear and warm. These winter winds from the northwest are described as strong and cold, sometimes extremely so, an instance of which occurred during December, 1874, when ice an inch in thickness was formed in the middle of the island, accompanied by two inches of snow, which was followed by hail and five days of cold rain. In summer these winds have less force, though still brisk and chilly for much of the time; and the fogs, instead of being carried over the central ridge, are driven around the northern end, and by eddy-winds are borne into the lower cañons of the eastern side, which are thus made cooler than the region above them. Otherwise the summer months are intensely hot, especially in the southern portion of the island, and the soil becomes soon everywhere so dry that the effect of the temporary summer fogs upon the vegetation is slight. The difference in the seasons, however, at the two extremities of the island is remarkable, as vegetation at the southern end and in the eastern cañons is at least two months earlier than in the northern and western portions, and has for the most part reached its maturity by the close of May, under the then established heats of summer. The annual amount of actual rain-fall is very variable, there being an abundance in some years, and in others little or none.

Guadalupe was early known to the navigators of these seas, but it was never permanently occupied. There are evidences of its temporary occupation by shipwrecked sailors, and it was also long ago stocked with goats[1] for the purpose of supplying fresh meat to vessels short of provisions or suffering from scurvy, and, ough out of the general course of travel, it has been occasion-y visited on this account. Twelve years ago an expelled gov-ıor of Lower California took refuge here with his family, and nained for two years. Soon afterward a party of men from the ne state lived for some months upon the island, engaged in ling the goats. During the last ten years it has been oc-pied by a California company, by whom it was purchased for purpose of raising the Angora goat, and the island is now rrun by these animals. Several men are kept in continual rge of them, and regular visits are made by the vessels of the npany.

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[1] It is said that this was done by Captain Cook, who, however, was never upon this part of the coast. Vancouver passed near the island in 1793, but without stopping.

Vith thus much of preliminary remark upon those conditions ich must affect the vegetation of the island, we may pass to flora itself. As respects the probable sources from which this a may have been derived, it is evident that there has been ındant opportunity for the introduction of some species by hu-n agency. These should be especially expected near the usual ding-place upon the eastern side, excepting such as would be bably distributed through the island by means of the goats. ose of most recent introduction in this way would doubtless be ifornian; the older might be from the nearer peninsula or n other localities. Of other recognized agencies for the dis-ution of plants, — the winds, ocean currents, and birds, — the valent direction of the first from the northwest is adverse to supposition that any species of phænogamous plants, at least, ıld be so introduced. The ocean currents might be considered nore favorable, and as likely to bring accessions from the Cali-ian main-land, contributed from the interior by the Sacra-ıto and other smaller streams. But the winds here again ıld prove an interposing agency, and by creating a surface-t toward the coast would prevent floating seeds from attaining great distance from it. Such as did succeed in reaching the ıd, and in obtaining and maintaining a foothold upon it, ld probably be wholly Californian. Less certain conclusions ht be expected in regard to the agency of birds, but it ap-s, from the collection of the birds of the island made by Dr. ner, that they are all in some measure peculiar to the island f, "consisting almost entirely of familiar forms of the birds ıe Western United States, but showing marked peculiarities, tling them to recognition as geographical varieties. Nothing ican about them in the slightest degree."[1] So that, though they demonstrate a connection between the island and California, yet they also indicate that that connection has been only at a remote period, and that their participation in the introduction of plants must have been slight.

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[1] Prof. Spencer F. Baird, in letter.

It might therefore be conjectured, if the island were of comparatively recent formation and always disconnected from the main-land, that its flora would show a meagre list of species almost wholly Californian. Or if, on the other hand, it had at some time been connected with the continent, that then its vegetation would be similar to that of the adjacent peninsula, unless some counteracting influence should have been at work, as would seem to be true of the birds.

To show to what extent the flora of Lower California differs from that of California proper, reference may be made to the list of plants collected by Xantus at the lower extremity of the peninsula,[1] as given by Dr. Gray in the sixth volume of the Proceedings of this Academy. Of the one hundred and eighteen phænogamic species there enumerated, only six are probably found even in extreme Southern California, while thirty others range northward only as far as Sonora, or eastward through Mexico to New Mexico or Texas, the remainder being peculiar to the peninsula or exclusively Mexican. The peninsula shares in this difference with Mexico itself, the type of whose whole flora accords rather with that of the eastern portion of the continent northward, except so far as it would necessarily be affected by the more tropical character of the climate. Of this a good and sufficient illustration is seen in the fact that of the *Phaseoleæ*, a tribe which is well represented in all the Atlantic States, Texas, Southern New Mexico, Eastern Arizona, Sonora, Lower California, and all of Mexico southward, not one species is found within the limits of California, nor in the interior basin west of the Rocky Mountains.

The only collection that we have of the plants of Guadalupe is that made by Dr. Edward Palmer during the last season, from February to May, which is probably as complete as was possible, though attended with much labor and difficulty. He visited all parts of the island, often finding it necessary to reach places which the goats had found inaccessible, in order by means of ropes and poles to secure rare specimens of species which appeared to have

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[1] The island of Guadalupe is equally distant from San Francisco and Cape San Lucas, but three degrees of latitude nearer to the latter point; and the difference of latitude between the cape and San Diego is little greater than that between Guadalupe and San Francisco.

en elsewhere completely extirpated. The entire number of
ecies is one hundred and thirty-one, including one hundred and
o exogenous and eight endogenous, the remaining twenty-one
longing to the higher cryptogamic orders, — ferns, mosses, and
erworts. Omitting a single phænogamous species (a *Heu-*
ra), of which the material is insufficient for a satisfactory de-
mination, the remaining one hundred and nine may be divided
o five groups: (1) Introduced species, of which there are
elve; (2) those that range from the Pacific to the Atlantic
tes, of which there are nine; (3) those that are found
oughout California, or at least as far north as San Francisco,
nbering forty-nine; (4) those found only in Southern Cali-
nia, below Los Angeles, or in Arizona, numbering eighteen;
ly, those peculiar to the island itself, of which there are
nty-one.

The twelve species[1] of whose comparatively recent introduc-
there can be little doubt are all of European origin, and
fly from Southern Europe, and are all also found more or less
ely naturalized in California. The original introduction of
t is probably due to the Spaniards, at least upon the main-
l, where the extent to which several have become distributed
mething marvelous. The most remarkable is the Alfilaria
odium cicutarium), which, unlike the wild oat (*Avena fatua*),
not been limited in its range to the western side of the Sierra
ada, but is found through much of the interior, from New
ico to Washington Territory. On Guadalupe it is found
ywhere, and is more abundant than any other plant. An-
r species of the same genus (*E. moschatum*), provided with
same contrivances for securing the dissemination and plant-
of its numerous seeds, occurs less frequently both here and in
fornia; probably because, requiring more moisture, it is un-
to maintain itself where the other will flourish. Another
nce is the *Oligomeris subulata* of India, Egypt, and the Ca-
Islands, found also in Southern California, and common east-
l through the valleys of the Lower Colorado and of the Gila
e Rio Grande, and in Northern Mexico. It is difficult to ac-
t for the wide-spread distribution of this plant, if of recent
duction, through a region so desert and sparsely inhabited.

esides these twelve species placed in the first group, there are
others, also found in California, which are considered identi-

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rassica nigra; Oligomeris subulata; Silene Gallica; Malva borealis; Erodium
ium and *E. moschatum; Sonchus oleraceus; Anagallis arvensis; Solanum nigrum;*
podium album; Avena fatua; Bromus sterilis.

cal with South American forms (*Specularia biflora* and *Amblyopappus pusillus*), possibly introduced from Chili or Peru, perhaps indigenous to both regions. Their presence on Guadalupe would perhaps rather favor the belief that they are native to our western coast, especially as five other South American species, or forms of them, occur in the Guadalupe flora (*Jillæa minima*, *Gilia pusilla*, *Plantago Patagonica*, *Parietaria debilis*, and *Muhlenbergia debilis*), which are more or less frequent in California and eastward in the centre of the continent, and are generally admitted to be native. There are, therefore, ninety-seven phænogamous plants which may be considered as indigenous.

It is evident, therefore, that, as regards the species common to the island and the main-land, the flora may be said to be exclusively Californian in its character. Not a single species is found that is peculiar to Lower California or Mexico. The same alliance is nearly as prominent if we look at the twenty-one new phænogamous species of the island. Fifteen of these (a *Thysanocarpus*, a *Sphæralcea*, a *Lupinus*, a *Trifolium*, an *Œnothera*, a *Megarrhiza*, a *Galium*, a *Hemizonia*, a *Perityle*, a *Bæria*, a *Mimulus*, a *Pogogyne*, a *Calamintha*, a *Phacelia*, and an *Atriplex*) belong to genera largely or exclusively represented in California and the region east of it, and are mostly closely allied to the species of that region. The remaining six species include a *Lavatera*, a composite, a borraginaceous plant, a species allied to the olive, and finally a palm. The *Lavatera* is interesting as representing a widely scattered genus, not otherwise found in America, except as a second species occurs on the more northern island of Anacapa. The genus belongs chiefly to the region of the Mediterranean, where fourteen species are native; two others are confined to the Canary Islands; another has been discovered in Central Asia, and still another in Australia. The new composite is referred by Dr. Gray to a South American genus (*Diplostephium*), not otherwise represented in our flora, but of which there are eighteen species in the Andes from the equator southward. Of the borraginaceous and oleineous species Dr. Gray forms new genera; the one (*Harpagonella*) allied to the small genus *Pectocarya*, of which there is one Chilian species and two Californian, one of these also in the Guadalupe flora; the other (*Hesperelæa*) bearing no close resemblance to any other member of the olive family. On the other hand, the palm (*Brahea* (?) *edulis*), conspicuous on the island as the only representative of a tropical flora, is probably less nearly related to

he Central Mexican genus to which it is provisionally referred,
an to the genus *Livistona* of Australia. A congener of the
uadalupe species has recently been detected by Dr. Palmer in
e cañons of the Tantillas Mountains, near San Diego. . . .

As respects the cryptogamic vegetation, of the half a dozen
rns, all are frequent in California, one peculiar to the southern
rt of the State, another found throughout North America and
urope. Of the eleven mosses, two are strictly Californian
ecies, seven are common everywhere in the United States and
urope, and two are European species which had not previously
en detected in America. Of the four *Hepaticæ*, three are Cali-
rnian and one is considered new.

Reference should be made to the plants which by their abun-
nce and prominence give character to the vegetation. Among
ese the "sage-brush" and "grease-woods" of the valleys of
basin are duly represented by an *Artemisia* and an *Atriplex*,
ich share with a *Franseria* in covering large tracts, and in pro-
ting the soil and the smaller annuals from the winds and sun.
ees are numerous over much of the island, chiefly coniferous:
ine, belonging to a Southern Californian species, but peculiar
some of its characters; a juniper, common in California; a
ress, similar to and perhaps identical with a Mexican species
ich extends into California; and a small oak, which is common
oughout the State. To these is to be added the palm, which
requent in the southern cañons, growing to a height of forty
t, and bearing large clusters of edible fruit.

To conclude, it is apparent, from all that has been said, that this
le flora as a whole is to be considered a part of that of Cali-
nia, as distinct from the flora of Mexico. It may be inferred
that it has not been to any great extent derived from Cali-
nia by any existing process of conveyance and selection, but
t it is rather indigenous to its present locality. Moreover,
le it would indicate a connection at some period between the
nd and the main-land to the north, yet the number and char-
r of the peculiar species favor the opinion that they are rather
mnant of a flora similar to that of California, which once ex-
led in this direction considerably to the southward of what is
the limit of that flora upon the main-land. And, finally, the
ence of so many South American types suggests the conject-
that this, and the similar element which characterizes the
of California, may be due to some other connection between
e distant regions than any which now exists, and even that

all the peculiarities of the western floras of both continents had a common origin in an ancient flora which prevailed over a wide, now submerged area, and of whose character they are the partial exponents.

RECENT LITERATURE.

Huxley and Martin's Biology.[1] — The problem which has so frequently puzzled teachers in biology, namely, to know where to commence their instruction, has been most happily solved by Professor Huxley in his Elementary Biology. He has prepared a series of practical lessons which should be mastered by all who wish to lay a solid foundation upon which to build special knowledge in either zoölogy or botany. The plan followed by Huxley has been to take a small number of plants and animals readily obtainable under ordinary circumstances. Of these a short description is given, followed by detailed laboratory instructions; these should enable every student to know from his own knowledge the facts mentioned in the accompanying description. He will thus gradually learn biological terms, and obtain "a comprehensive and yet not vague conception of the phenomena of life." The plan of thus paving the way to special study by careful, practical work on a few forms is not a new one. The elder De Candolle used to say he could teach all he knew of botany from a few plants, while zoölogists until recently gained their first insight into the phenomena of life mainly from the study of vertebrates, and especially of man. It is only within a more recent period that the great development given to the study of invertebrates has trained a school of zoölogists who have begun at the lower end, so to speak, and who have always retained their predilection for invertebrates in opposition to those who, having studied human anatomy and physiology, have mainly devoted themselves to the vertebrates. The latter have always worked with the immense advantage of attacking their subject with knowledge gained in a field where the constants of the science, contrasted with those known from among invertebrates, were numerous, and where the beginner never stumbled at the outset of his investigations across structural features and phenomena most imperfectly understood.

It is greatly to be hoped that the introduction of such an admirable text-book as that of Huxley and Martin will not only break down the distinction existing between the two sections of zoölogists, but will also lead zoölogists and botanists hereafter to become biologists, while following the special department to which they may from inclination devote themselves as original observers.

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[1] *A Course of Practical Instruction in Elementary Biology.* By Professor Huxley and H. N. Martin. Crown 8vo. 6s. London and New York: Macmillan & Co. 1875.

This book is quite unique for a text-book on biology; it has not a gle figure. The student is called upon from the instructions to see t for himself what there is to be observed, then to make his own draw- s, a process which will surely and clearly show him, or his teacher, at he has omitted. The student has no possible chance, in giving an ount of what he has done, to repeat anything by rote, for should he low the usual practice of reciting the very words of the description, he hardly hope to give an intelligent reply to the questions of his cher, if the latter is properly fitted to guide him in his laboratory rk. The amount of solid information to be obtained by faithfully fol- ing the instructions given for the study of the frog shows the masterly d which has prepared the questions.

The total absence of discussion of any sort is as remarkable a feature this volume as the omission of all figures.

WHITE'S NATURAL HISTORY OF SELBORNE.[1] — Reading again this ightful record of quiet, shrewd observations of the habits of birds and kets, trees and plants, sticklebacks and hedgehogs, — in fact, the com- things of the wayside and hedgerow, — by an English country curate, have renewed the delights of our boyhood, when White's Selborne, dford and Merton, and the Swiss Family Robinson were the stand- books. But what a contrast this gorgeous edition to the little buff er-covered reprint in Harper's Family Library!

'o the letters of White to Thomas Pennant, Esq., whose name is so libly connected with American zoölogy, and to the "Honourable nes Barrington," are added some hitherto unpublished, a memoir he author, and over a hundred pages filled with a strange medley of s by Frank Buckland, the editor of the volume, illustrated by cuts nan-traps, a baby hedgehog, a mummied monkey, and other objects, rule more grotesque than useful, while Lord Selborne contributes e notes to the Antiquities.

he illustrations by Delamotte are exquisite and abundant, and the k is published in a style of elegance and luxury that will, we feel , lead many a country gentleman in America as well as England to it a conspicuous place on his drawing-room table.

NDERSON'S NORSE MYTHOLOGY.[2] — So much has been said in praise his book by scholars that we can add nothing by way of commenda- or criticism that will be of any importance. But aside from its lit- merits, and the interest that so fresh, enthusiastic, and apparently

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'atural History and Antiquities of Selborne.* By GILBERT WHITE. With Notes RANK BUCKLAND, a Chapter on Antiquities by LORD SELBORNE, and new Let- Illustrated by P. H. DELAMOTTE. London: Macmillan & Co. 1875. 8vo, 1. $12.00.

'orse Mythology; or, The Religion of our Forefathers.* Containing all the Myths Eddas, systematized and interpreted. With an Introduction, Vocabulary, and . By R. B. ANDERSON. Chicago: S. C. Griggs & Co.; London: Trübner & 1875. 12mo, pp. 473. $2.50.

reliable a study of Norse mythology possesses, the book, it seems to us, will prove of lasting value to the student of comparative mythology. If the Norsemen originally came from Asia, we have in this recent folk lore a descendant of a fossil mythology, and a means of comparison with the mythology of our American aborigines. When the time comes for a comparative study of our Indian traditions and legends, we may be able to discover some connection with the archaic myths of the Indians of the Old World which will throw some light on the origin of human life on our continent.

RECENT BOOKS AND PAMPHLETS. — A Romance of Perfume Lands, or the Search for Capt. Jacob Cole. With Interesting Facts about Perfumes and Articles used in the Toilet. By F. S. Clifford. Boston: Clifford. 1875. 12mo, pp. 295.

On the Superficial Geology of the Central Region of North America. By G. M. Dawson. (From the Quarterly Journal of the Geological Society, London, November, 1875.) 8vo, pp. 603–623.

La Maturation de l'Œuf, la Fécondation, et les premières Phases du Développement embryonnaire des Mammifères, d'après des Recherches faites chez le Lapin. Communication préliminaire. Par Édouard Van Beneden. Bruxelles. 1875. 8vo, pp. 53.

The Present Condition of the Earth's Interior. By Geo. F. Kittredge. Buffalo. 1876. 8vo, pp. 16.

First Annual Report of the Chicago Botanical Garden, December 1, 1875. Chicago. 1876. 8vo, pp. 4.

GENERAL NOTES.

BOTANY.[1]

THE PLANTAIN INDIGENOUS IN SOUTHERN COLORADO. — While with Holmes's division of Hayden's survey last summer, in Southwestern Colorado, I found the common dooryard plantain under such circumstances as to render it probable that it is indigenous there. With the exception of a few plants growing in a grass-plot where it was no doubt sown with eastern grass seed, I have never met with it in Eastern Colorado. Near the corner of the four Territories, on the sand-bars of the Rio Dolores and Rio de los Mancos, a part of Colorado inhabited only by Navajoes and Utes, it is quite common. This almost unknown region has rarely been visited by the white man, and the plant could not have been introduced by him. — T. S. BRANDEGEE.

VITALITY OF SEEDS. — Professor Ernst, of Caracas, contributes the following facts to this vexed subject. The Plaza Bolivar in Caracas was formerly a market-place, and until the year 1867 formed a square plain inclined from north to south. When the government decided to remove the market and use the grounds as a park, the place was leveled by digging away about six feet of the soil at the northern end. Of course a fresh surface was thus exposed to the air. A large number of rubbish

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[1] Conducted by PROF. G. L. GOODALE.

nts or very coarse weeds soon clothed the earth from which the six
of soil had been taken. But among the many plants which came
at the northern end of the plaza was a vast quantity of *Broteroa*
ervata, a species which is very restricted in its range near the city.
only locality from which the fruits of this plant could have been
ught by the wind was south of the plaza; but on account of the sur-
ndings of the city, south and north winds are unknown. It seems
ly to Professor Ernst that the seeds had remained under the cement
he old market-place for more than thirty years, and had been there
served unharmed. When the cement was broken up and the ground
led for the plaza, the buried seeds, or rather fruits, were exposed to
ospheric influences, to moisture, warmth, and air, and after the lapse
o long a time germinated.

he second case relates to a very common weed, shepherd's-purse,
ch, strange to say, is so rare at Caracas that it had not been met
in botanical excursions covering a period of twelve years. Two
s ago, in the southern part of the garden of the monastery a place
graded for the erection of a building. A great deal of soil was re-
ed and a wholly fresh surface was thus uncovered. Upon this spot
y weeds sprang up, and among them thousands of specimens of
sella bursa-pastoris, or shepherd's-purse. Professor Ernst concludes
in this case, as in the other, the seeds had remained dormant in
soil for an unknown period. These cases belong to the same class
hose mentioned by Hoffmann, and given in the January number of
NATURALIST.

ROPICAL TREES DURING THE DRY SEASON. — Professor Ernst, of
cas, states that many woody plants of the Venezuela flora lose all
leaves during the dry season, even when the ground is copiously
red for the purpose of preventing their fall. Several large-leaved
ts, such as *Cassia*, mahogany, and many others, exhibit this phenom-
. The new foliage starts usually when the rainy season sets in, but
rains come very late, as they did in 1875, many of these trees un-
their buds and develop the leaves at a period when the ground is
and hard, the tropical heat very intense, and the air extraordina-
dry. This curious periodicity has been casually noticed by several
rs, but no explanation has been hitherto offered. Professor Ernst
given this subject careful study, and now states that in general, those
which cast their foliage in the dry season have compound leaves of
r delicate texture. From such leaves transpiration is exceedingly
l, and early carries away all the available water. When there is no
moisture within reach of the plant, the leaves separate from the
. In this wholly or partially leafless condition the trees remain
the end of April or the beginning of May, when the moist winds
the northwest, as precursors of the tropical rains, awake the slum-
g vegetation. Of course the trees cannot absorb by their parts

above ground any great amount of moisture, if they do any at all, but the slight transpiration which had been going on from stems and young shoots is now checked. The small amount of moisture which the roots can take from the parched soil is not without speedy effect upon the branches and buds to which it is carried. The buds soon open. But in the spring of 1875, when there was not a cloud to be seen in May, and the west wind at evening brought little relief from the scorching drought of the day, and the baked crust of the soil everywhere showed no trace of moisture, the trees put forth their leaves as usual! Now the first case is easily explained; how about this one, which seems so different?

At the outset, Professor Ernst admits that the individual nature of the plant, the age, the condition as regards health, etc., must be carefully investigated. This he has not yet done. He goes on, however, to say that it is generally understood that the only external excitant to growth is the warmth of the air. Since in the dry season there is, as he states, a difference between the temperature in the sunlight and at night of about twenty-seven degrees Fahr., this must cause very great changes in the volume of the gases held in the spongy tissues of the tropical trees. The pressure is very variable, and he assumes that the fluctuations must cause motions of nutrient liquid. He further assumes that when these juices are brought to the terminal cells of a bud, growth must result, and the leaves must unfold. It must be confessed that Professor Ernst has made a fair use of Krutzsch's observations in regard to the temperature of stems and twigs as affected by the surrounding temperature, and he appears to have skillfully applied the mechanical theory to this case, but he has not as yet done much to solve the riddle of periodicity of vegetable rest.

Eccentricity of the Pith of Rhus Toxicodendron. — My attention was drawn to this subject by the January Naturalist. As is well known, this handsome but much-dreaded climber, so common in all our woodlands, has the habit of adhering tightly to the trees which it ascends by a multitude of aerial rootlets, which often cover its stem and give it the appearance of being embedded in a cushion of moss.

The results of my investigations on the stems of this plant are somewhat curious. The fact itself that the pith, wherever the vine is found adhering closely to living trees, lies very near the outer side, leaving a largely disproportionate amount of the woody tissue on the side next the tree, is, so far as I have observed, universal. The following observations will give an idea of this disproportion: —

In a vine 5½ lines in diameter the distance from the centre of the pith to the inner margin was 4¾″, and to the outer only ¾″. This proportion held uniformly for various heights from the ground. The measurements included the bark, which, as well as the annual rings, partook of the general tendency, and was much thinner on the outer side.

A larger vine, upwards of an inch in diameter at the base, had climbed

cedar-tree (*Juniperus Virginiana* L.) to the top, and, no longer finding
ıything to adhere to, sent out free fruiting branches nearly half an inch
ick. Of this I took several measurements. Two and a half feet from
e ground, where the diameter was 10½″, the distance from centre of
th to inner edge was 8½″, and to outer 2″. A foot lower the propor-
n had decreased to that of 9″ to 2½″ in a diameter of 11½″. Ten
ches lower still it had further decreased, so that the pith was still 9″
m the inner, but 4½″ from the outer margin. The ratios between the
o distances in descending the stem were therefore, respectively, 4¼,
, and 2. Above the first-mentioned point the position of the pith re-
ined nearly unchanged.

A very large vine, nearly four inches in diameter, gave less marked
ults. Sections not being exactly circular, linear measurements could
t be relied upon, but a line drawn through the heart, parallel to a tan-
nt at the point of contact with the tree to which it adhered, showed
lecided preponderance of wood in the inner segment. The adhesion
this case, however, as is probably the case with all large vines, was
ght, the rootlets appearing to lose their vitality with age. The vine
ided at the height of eight feet, and the branches, which adhered more
sely, showed a greater eccentricity.

Numerous observations were made on other vines thus normally situ-
d, with substantially the same results. One case in particular, how-
r, exhibited the extreme of the phenomenon, the cellular dot ap-
aching to within a fourth of a line of the membranous bark. Indeed,
anxious did it seem to remove itself to the greatest possible distance
m the tree that for the greater part of the way there was a manifest
ge running along the back of the stem, in which the pith was situated.

These facts, however, uniform and singular as they are, could not in
mselves be regarded as sufficient to demonstrate the absorption of sap
n the supporting trees by the rootlets. To satisfy such an assump-
certain tests must be applied. The first that suggested itself to me
that of making similar observations at points where, for any reason,
vines had swung loose from their support, so that no connection
uld exist by means of the rootlets. Many such cases were found and
mined. The larger vine first referred to, which at a distance of two
and a half from the ground, where the attachment was firm, meas-
d 8½″ to the inner and 2″ to the outer margin, giving a ratio of 4¼
veen the measurements, had the pith located 5¼″ from the inner and
from the outer margin, a ratio of 1⅔, at a point some six feet higher,
re it had become detached. In this example it was evident that
e had formerly existed some degree of attachment. At other points
er up, where there were less signs of its having ever adhered, the
was found to be nearly central, while on the projecting branches of
same vine, bearing the berries and showing no tendency to cling,
e was no appreciable eccentricity. Another small vine, which ad-

hered for four feet and then swung away for two feet, reattaching above, had the pith decidedly more central at the detached part than at points either above or below. The extreme case to which I referred, where the pith actually ran through a tube slightly raised above the outer surface, showed a transition from this state of extreme eccentricity to one of centrality in the space of one foot where the vine suddenly abandoned its support.

The function assigned to the rootlets by the hypothesis is one of parasitism. They are assumed to penetrate the bark as far as the cambium layer, and remove the sap of the tree, appropriating it directly to the vine. This nutrition, being ready-made, would naturally be deposited at the nearest point of contact, and thus account for the great preponderance of woody tissue found on the side next the tree. It would therefore follow that this eccentricity of pith should not exist where the support is not a living tree. To test this question, I sought out a small vine of the same species which climbed and closely adhered with a profusion of rootlets to a perfectly dry stone wall ten feet in height. This I examined most carefully, and accurately measured at various points, finding the position of the pith uniform at all distances from the ground. The following measurement will therefore answer for all: Three feet from the base, where the diameter was 4¾″, the pith was 2¾″ from the inner and 2″ from the outer edge, or within three fourths of a line of the centre.

One other class of instances seemed to bear directly on this point, and to these I gave special attention. I refer to vines found climbing fences and posts under varying circumstances. The results obtained from these were perhaps the most surprising of all. One 5¼″ in diameter tightly hugged a decayed fence post, insinuating its rootlets deeply into the soft surface. Of this the pith was 4″ from the inner and 1¼″ from the outer margin, giving the astonishingly large ratio of 3⅕. A section of a larger stem (11″) similarly situated, and whose rootlets tore away considerable of the decayed wood in detaching it, showed the centre of the pith to be 7″ from the inner and 4″ from the outer margin. Considering the size of this vine the eccentricity was large.

Where the wood to which the vines adhered was not decayed or soft, a marked diminution in the eccentricity was perceptible. In one instance where the rootlets clung very tightly to a dry surface, which had moreover been charred and where penetration was impossible, the measurements were respectively 3½″ and 2½″, or an eccentricity of half a line in a diameter of half an inch.

So far as my observations, which were numerous, extended, it seemed to be the law that, *cæteris paribus*, the softer the wood to which the rootlets adhered, the greater the eccentricity of the pith.

Without going further into details, therefore, the whole subject may be thus briefly summed up: —

(1.) The pith of the poison ivy, wherever the vine is of moderate size, d is found adhering closely either to the bark of a living tree or to any ft, decaying substance, is located from three to ten times nearer the ter than the inner side of the stem, and sometimes still more eccen- cally; the annual layers of wood as well as the bark becoming corre- ondingly thickened on the side next the support.

(2.) This eccentricity diminishes and frequently disappears altogether points where there is no attachment by the rootlets.

(3.) It is greatly reduced in vines which cling to hard substances ich the rootlets are unable to penetrate, as a stone wall or a dry post.

That all these facts are in harmony with the theory of the absorption nourishment from the support, in so far as any form of parasitism is plied, cannot of course be maintained. The last class of observations cribed may be regarded as directly negativing such an assumption. sides, I have seen nothing to render it probable that the rootlets ever rce the outer bark. But, on the other hand, these facts do all unite pointing to a physical connection of some kind between the penetra- i of the rootlets and the eccentricity of the pith. The notion thus far ertained, and which has found its way into our standard text-books, t these rootlets are "not for absorbing nourishment, but for climb- ,"[1] may in future require some modification. Yet, admitting this sical connection, there remain puzzling physiological questions. If se rootlets perform the function of true roots, and find congenial soil the corky layer of bark, in the soft mass of decomposed wood, and n to some extent in the minute cryptogamic vegetation that always its among them even when clinging to walls of brick or stone, how s this explain the singular behavior of the pith and the strange ntricity of the annual rings? — LESTER F. WARD.

ETS of Dr. Edward Palmer's recent collection of plants of San Diego , California, and of the Tantillas Mountains in Lower California, near boundary, will shortly be ready for distribution. They will probably nber about three hundred species, and will be sold at ten dollars per dred. Address Sereno Watson, Cambridge, Mass.

OBINIA HISPIDA. — Can any of our readers procure specimens of *fruit* of this plant for Professor Gray, of Harvard University, Cam- ge? The pods are almost unknown.

OTANICAL PAPERS IN RECENT PERIODICALS. — *The Journal of Bot-* (Trimen), February. S. Kurz, On the Species of *Glycosmis* (plants ie orange tribe). A. E. Eaton, Plants of Spitzbergen. H. F. Hance, Orchids from Hong Kong. Reichenbach fils, Descriptions of three its. W. B. Helmsley, Notes on the Flora of Sussex. R. A. Prior, *Rumex hydrolapathum* and *R. maximus*. G. Dickie, On Marine e from Kerguelen Island. M. J. Berkeley, On a New Agaricus Kerguelen Island. Dr. Gray's paper on Æstivation and its Termi- gy is reprinted in this number.

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[1] Gray's Lessons, page 34.

Comptes rendus, January 3d. Duchartre, Conclusions respecting the Production of Saccharine Matters in Plants. E. Heckel, Floral Glands of *Parnassia palustri.* January 10th. R. Corenwinder, On the Diminution in the Amount of Sugar in Beets, during the Second Period of their Growth.

Annales des Sciences naturelles, December, 1875. P. Duchartre, On the Bulbs of *Lilium.*

Flora, No. 33. Dr. Lad. Celakovsky, On Intercalated Epipetalous Stamens. F. Arnold, On the Lichens of the French Jura. Nos. 34 and 35. C. Müller, New Grenada Mosses. Dr. K. Prantl, Morphological Studies. No. 36. O. Böckeler, On certain Carices. This number contains a very long and interesting review of Darwin's Insectivorous Plants. No. 1. Hugo de Vries, On the Wood formed during Repair of Wounds in Trees.

Botanische Zeitung, No. 2. On the Palmella State of *Stygloclonium*, by L. Cienkowski. On the Influence of Light on the Color of Flowers, by E. Askenasy (elsewhere noticed). No. 3. Botanical Miscellany, by Dr. A. Ernst (abstracts of these notes are given above). On the Behavior of Yeast in Liquids free from Oxygen Gas, by M. Traube (controverting the views of Brefeld). No. 4. The Development of *Basidiomycetes*, by Oscar Brefeld. (A review of some recent publications, especially those of Reess and Van Tieghem.) No. 5. Investigations respecting Growth, by J. Reinke (not finished). On the Rate of Movement of Water in Plants, by Dr. Pfitzer (to be hereafter noticed). In the report of the Bonn society, Professor Pfeffer's papers on the Formation of the Primordial Utricle, and the Production of High Hydrostatic Pressure by Osmosis, previously noticed in this journal, are given with considerable fullness. No. 6. On the Morphology of the Araceæ, by Dr. A. Engler (not finished).

ARBEITEN DES BOTANISCHEN INSTITUTS IN WÜRZBURG, herausgegeben von Professor Dr. Sachs. Erster Band. This volume of contributions from the Botanical Institute at Würzburg comprises four parts, which have appeared at nearly regular intervals since 1871. The work can therefore be ranked among periodicals. In the present notice we shall give very briefly a sketch of the memoirs, hoping to present fuller outlines of several of them in subsequent numbers of the NATURALIST. 1. Dr. W. Pfeffer, On the Action of Colored Light on the Decomposition of Carbonic Acid in Plants. (By an improved method of research the following results were reached: Only the visible rays of the spectrum can decompose carbonic acid; in fact, those which seem brightest, namely, the yellow rays, are alone as efficient in this work as all the others combined. The most highly refrangible rays of the visible spectrum, and those which act most energetically on chloride of silver, etc., play a subordinate part in assimilation. Each color in the spectrum has a definite quantitative effect on the activity of assimilation.) 2. Dr. W.

effer, Studies respecting Symmetry and Specific Causes of Growth. n examination of the influence of surroundings upon the growth of a erwort.) 3. J. Sachs, On the Influence of the Temperature of the Air d the Effect of Daylight on the Periodical Changes in the Rate of owth of Internodes in Length. (See abstract in Sachs' Text-Book, page 5 *et seq.* In the memoir, Professor Sachs has given a very full *résumé* the literature of the subject.) 4. J. Sachs, On Negative Geotropism. bservations respecting the curving upwards of shoots from a stem ced horizontally.) 5. J. Sachs, On the Deflection of Roots from their rmal Direction of Growth by Contact with Moist Surfaces. (See tract in Sachs' Text-Book, page 764.) 6. Hugo de Vries, On some uses of the Direction taken by Parts or Plants which possess Bilat- l Symmetry. (The effects of gravitation, light, defoliation, etc., are mined. The views of Frank are contested. See Text-Book, page .) 7. J. Sachs, The Plant and the Eye as Different Tests for Light. chs had early insisted upon a distinction between objective intensity light and its brightness to the eye. Prillieux in a paper on the sub- is thought to have overlooked these distinctions, as well as that be- en refrangibility (objective) and color (subjective). In the present moir Professor Sachs reviews the literature of the subject, defends former position, and further explains the relation between the inten- of light and the activity of assimilation.)

ZOÖLOGY.

HE CROSSBILL BREEDING AT RIVERDALE, N. Y. — This bird *xia curvirostra* var. *Americana*) made its appearance here last au- n, November 3d. Small flocks were occasionally seen all winter, through March and April, feeding on seeds of cones of the Norway ce and larch. On April 22d I noticed a pair building near the top red cedar, about eighteen feet from the ground. The nest, April , contained three eggs, and was composed of strips of cedar bark, dried s, and stems of the Norway spruce, and was lined with horse-hair, ers, dried grass, and fibrous roots. The eggs were about the size of e of *Junco hyemalis*, in color very light blue, slightly sprinkled and hed at the large end with dark purple. I saw a small flock of six ese birds May 10th, which were the last seen here. Riverdale is on Hudson River, sixteen miles north of New York Bay. — E. A. KNELL.

EWICK'S WREN (*Thryothorus Bewicki*), although not a well-known to those not ornithologists, is not "something of a rarity" in the le Atlantic States, as stated by Dr. Coues in the January number of NATURALIST. I have not failed to find considerable numbers of for several years past. They appear to have a strong attachment ertain localities, and, if undisturbed, will return year after year to the same spot to breed. An interesting feature in the habits of this species is the marked variation of their vocal powers. While some are remarkably fine singers, others are very commonplace, or else too lazy to exercise their capabilities. — CHARLES C. ABBOTT, M. D., Trenton, N. J.

FLOWERS OF THE GOLDEN CURRANT PERFORATED BY HUMBLEBEES. — In Part 7 of Half-Hours with Insects, page 202, it is stated that the first and only instance known in this country of the curious trait of the humblebees of perforating the corollas of flowers to get the honey is given by Mr. W. W. Bailey in THE AMERICAN NATURALIST, 1873.

Last spring a cluster of *Ribes aureum* growing in my dooryard was visited by humblebees, and I noticed that they always extracted the honey through perforations in the bases of the calyces made by their mandibles. When at least three fourths of the flowers had been despoiled in this way, so great was their dexterity that seven flowers per minute were found bitten open and robbed of their honey. The same was noticed by Mr. Struthers, of Fort Atkinson, on the flowers of *Robinia pseudacacia*, in 1863. — W. F. BUNDY.

HABITS OF WESTERN BIRDS. — As we encamped on Antelope Creek, Nevada, May 28th, I at once proceeded to procure specimens, and in following up the stream a short distance I came upon a thicket of willows, in which I found a large nest, occupied by one of the parent birds. After securing the bird, which proved to be the female of *Buteo Swainsoni*, and crawling up to the nest for the eggs, I noticed a slight commotion amongst the leaves but a short distance away, which upon examination proved to have been caused by a pair of Bullock's orioles (*Icterus Bullockii*), which were also breeding. Both of these nests were about twelve feet from the ground, only eight feet apart, and unprotected from above, by the absence of any branches or leaves. The orioles had certainly built in a dangerous locality, and must have been entirely unmolested by the hawks, as the eggs in both nests were far advanced in incubation.

Later in the season (August) we camped at Big Pines, Owens Valley, Cal., where we saw great numbers of humming-birds flying around the tops of the pine-trees. Towards evening some were seen near the ground, and after watching them very closely for a while I saw one alight close by, which soon after flew to its nest. The nest was built upon a small cottonwood branch, exactly over and but about two feet above a perfect torrent of water rising in the glacial summit of the Sierra Nevadas. The species (as Professor Baird has since informed me) was *Stellula Caliope*. The nest, eggs, and skins, with those above referred to, are now at the Smithsonian Institution, together with the general collections.

In the December number of the NATURALIST for 1873, Mr. Allen answers Dr. Barrett (?) in reference to the supposed geographical "distribution," or rather range, of the crow and raven. As he says, they are

egarious throughout the region over which we passed in 1873, Yel-
wstone River, etc., and I can say the same of Nevada, in the valley of
e Payhee and Humboldt rivers. Frequently, while working our way
wly up the Grand Cañon of the Colorado River, where the plateau
s over six thousand feet above us, with walls at an angle (from
se to summit) of nearly eighty degrees, we found numbers of crows
d ravens flying over our heads, or perched upon the projecting ledges
sandstone or basalt. Rather dismal to hear the croaking in such a
ality, — the bottom of a gorge, one and a quarter miles below the sur-
e. — W. J. HOFFMAN, M. D.

REMARKABLE STRUCTURE OF YOUNG FISHES. — Dr. Günther, of
ndon, has recently discovered that the young of the sword-fishes and
ætodus possess structures exceedingly different from that of the adult.
the young *Chætodus* the front of the body is shielded with large bony
tes, which in one species are produced into three long, equidistant
ns, which diverge ray-like from the body. In the sword-fishes the
pular arch is prolonged into a horn at the lower part, and the belly
are wanting. There is no sword, but the jaws are long, of equal
gth, and both are furnished with teeth. As the fish grows, the scap-
r horn disappears, the ventral fins grow, and the upper jaw is de-
oped in excess of the lower. The long teeth disappear, and the
er jaw grows into the toothless, sword-like weapon which gives the
its peculiar character.

NUSUAL NESTING SITES OF THE NIGHT HAWK AND TOWHEE
NTING. — A letter from Mr. William Couper, of Montreal, speaks of
having found the eggs of *Chordeiles popetue* on the flat roofs of build-
in that city, and the nest of *Pipilo erythrophthalmus* in a small tree
ut three feet from the ground. In each of these cases the departure
the usual habit of the species is decided. — ELLIOTT COUES.

GGS OF BOA-CONSTRICTOR. — My friend, Dr. Kunzé, has shown
an infertile egg of a boa which he lately obtained at the Central Park
agerie. The boa laid twenty-one eggs, each about the size of a
s egg. The animal made the deposit in sight of her keeper and
rs. She laid two fertile eggs, and then a sterile one, in regular
ession; each third egg was sterile. The fertile eggs had each a
ng boa within. One came out of its shell immediately after being
but soon died. All the others died within their shells. The sterile
were albuminous throughout, and cut like cheese and smelled like
m oil. Could this be the balance of an impregnation received the
before? — S. LOCKWOOD.

MALL BIRDS CAUGHT BY THE BURDOCK. — At Lake George, a gen-
an presented me with a skeleton of a humming-bird, firmly fastened
ome burs, which he found on a burdock; and at the same time he
d a live one on a plant near by. I was walking along one of our
try roads, when I saw a yellow-bird (*Chrysomitris tristis*) fluttering

on a burdock, and when I stooped to catch it, it tore itself away, leaving a number of its feathers on the burs. A few days after, I caught a yellow-rumped warbler (*Dendroica coronata*) fastened to the same kind of plant. — A. K. FISHER.

ANTHROPOLOGY.

ANTHROPOLOGICAL NOTES. — Those who attempt to institute a comparison respecting the elaboration of culture in the Old World and in the New, and to sum up the contributions of nature in the two hemispheres, must not forget that in the western men wrought only with their hands, that they had the service of not a single tractive animal, of no beast of burden excepting the llama, that they had no cows for milk, no domestic animals for slaughter; and but for the faithful wolf-dog, the aborigines of North America would have been absolutely cut off from the advantages of those friends of man which in the eastern hemisphere are indissolubly linked with progress.

The railway companies of Western Germany having taken steps to secure and preserve all historical and prehistorical relics found in their gradings, some rich discoveries have been their reward. At Durkheim a highly ornamented Roman tripod inlaid with gold and other metals was found. Near Eisenberg, a Roman grave with rich deposits was opened.

Prof. George Rolleston's paper in the *Journal of the Anthropological Institute* (v. ii. 120), On the People of the Long Barrow Period, is a very interesting treatment of the subject. We can extract only a few sentences. As to the physical characteristics of the people, the male skeletons were very generally about 5.5 feet, the female 4.8 feet. The average difference between the statures of males and females in civilized races is about half this amount, while a precisely similar disproportion is observable at the present day in the stature of individuals of the two sexes among savages. In studying the skulls we are to take into account what the author, quoting Professor Cleland, calls "ill-filledness," or the presence of ridges and depressions occasioned by scanty feeding and lack of comfort. Speaking of the age of the barrows, there is no doubt that they are the first sepulchral evidences of the existence of man in Britain. Pristine or priscan man, like the modern savage, grudged no labor less than that which was spent in piling up a huge mound. Mr. H. W. Mosely, naturalist to the Challenger, in recording his observations on the Kudang tribe of Australia, living near Cape York, says that though they are destitute of almost everything in the way of property, having neither perforated stones to help them dig roots, as have the Bushmen, nor boomerangs, nor tomahawks, nor canoes; living not on the available wallabies and phalanges, but on fish, reptiles, invertebrates, and vegetables; having the scantiest clothing; being, finally, below savagery, as understood by a good judge of it, Professor Nillson, in having no

iefs, — they nevertheless take great pains with the burial of their dead,
rking out and adorning the graves with posts, and decorating them
th the bones of the dugong. None of them have any metal imple-
nts; tanged and barbed arrowheads are wanting in them. When
taining any burnt bones, the latter never occur in urns, and a large pro-
tion of the bones present the manganic oxide discoloration. The im-
nse majority of long barrows in the south of England were erected for
umation, whereas exactly the reverse has been the rule in the north
nties.

n the whole, indications are not wanting which suggest that inhuma-
will ultimately be shown to have been the earliest mode of burial
cticed in these as yet the earliest known sepulchres, and that inhumation
galleried chambers was probably the earliest variety practiced, at least
ere the necessary slabs of such chambers and passages were available,
that burial without burning, and also without any cist or chamber
tever, may in other districts not so conditioned have been contem-
aneous with burial in chambers; and, finally, that inhumation in cists
hout passages leading down to them, and cremation, mark later epochs
he Long Barrow Period. The plan of cremation was that of pack-
the bodies in all states of decomposition along the central axis, to-
er with wood and stones; the combustible and transpirable mass
hed half the length of the barrow. Whatever was done in a crema-
barrow was done at one time, once and for all.

acmillan & Co. have published during the last year a work en-
d Angola and the River Congo, by Joachim John Monteiro. The
or speaks very disparagingly of the prospects of civilizing the na-
. The same gentleman has a paper on a kindred subject in vol. v.,
ii., of the Journal of the Anthropological Institute.

. Clermont Ganneau reviews the ancient inhabitants of Palestine in
August number of *Macmillan's Magazine*. The London *Athenæum*
ecember 11, 1875, contains a letter from the Rev. Selah Merrill,
æologist of the American Palestine Exploration Society, in which
ports a visit to Um El Jemal, the Beth Gamul of Jeremiah, in the
hborhood of Bozrah and Salchad.

rofessor Fischer, director of the Mineralogical and Geological Mu-
of Freiburg, Baden, has sought to organize a new branch of anti-
ian study, namely, mineralogical archæology. His object is to as-
in, by a microscopical and chemical examination of nephrite, jade-
nd other substances of which stone implements are made, the ex-
ource of these materials, and also the migrations of the people who
them.

Indian Rock-Shelter in Lancaster County, Pennsylva-
— Professor Haldeman has lately discovered an interesting series of
n relics in a small cave, or more properly rock-shelter, at the west-
ide of Chickis Rock, Lancaster County, Pennsylvania. This rock

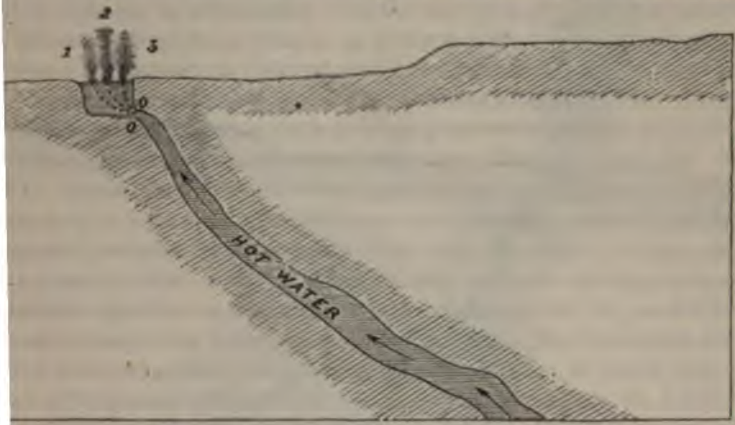
or cliff, he informs me, is of quartzite (Potsdam sandstone), which has the curve of an anticlinal axis, the base of which may be called a cave. This is arched, high enough for a man to stand at the entrance, with the roof declining backwards and on each side to the ground; the width and depth about twelve feet. The "find" of specimens consists of one hundred and thirty arrowheads, of quartz, jasper, limestone, and chalcedony; one banner-stone or sceptre, a perforated implement resembling a tomahawk; eight chisels, mostly of quartz; two pipe-stems, three net-sinkers, and about one hundred fragments of pottery. As the characteristic specimens of this find, with full details of their discovery, will shortly be illustrated and described, we will not refer more particularly to them. The specimens here briefly referred to were found beneath a deposit of rich black mold, varying from two and one half to three feet in depth. If this deposit is solely due to the decomposition of vegetable matter, the contained relics indicate that very far back in the past the red man had arrived at an advanced stage of neolithic culture; for the specimens as a class are of excellent workmanship. — CHARLES C. ABBOTT, M. D.

THE TASMANIANS. — In a recent memoir on the osteology and peculiarities of the Tasmanians, who have recently become extinct, Dr. J. B. Davis records his belief that they represent a type distinct from the Australians. Besides presenting osteological differences, the Tasmanians never used the boomerang or shield, although they had a larger brain, and were intellectually superior to the Australians. Like the Australians, however, the Tasmanians never made pottery. Although Tasmania is situated but a little more than three hundred miles from Australia, Davis thinks there was never any communication between the two peoples. In confirmation of this view he states that the Tasmanians neither had native dogs nor practiced circumcision, a custom very general among the Australians. "All that can be said with truth is that the Tasmanians are not Australians, they are not Papuans, and they are not Polynesians. Although they may present resemblances to some of these, they differ from them all substantially and essentially. From all this we are justified in asserting that the Tasmanians were one of the most isolated races of mankind which ever existed; that they were a peculiar and distinct race of people, dwelling in their own island, and different from all others. And they have been one of the earliest races to perish totally by coming into contact with European people." The population of Tasmania at the time when first visited by Europeans was between four thousand and seven thousand. The last native died three years since.

GEOLOGY AND PALÆONTOLOGY.

HOT SPRINGS AND GEYSERS. — We extract from Prof. T. B. Comstock's Report on the Geology of Wyoming the following remarks on the difference between hot springs and geysers: "In the ordinary hot

ing the spurting of the liquid, when it occurs, is owing to a resist-
ce offered to the direct escape of the expansive force from below, and
s resistance may be found in the tenacity of the liquid contents of the
wl, in the untoward shape of the bowl or its connected passages, or in
sudden restriction of the orifice near the surface of the liquid. In
her case the uprising force is condensed, as it were, near one point,
l the spurt or eruption is caused by the sudden overcoming of the ten-
when the force has become sufficiently concentrated to free itself
n its confinement. Thus we may meet with a great variety of spout-
thermal springs, resulting from two or more of these causes com-
ed, and the force may be produced by heat alone or by the evolution
arbonic acid or other chemical change in addition. (See Figure 14.)

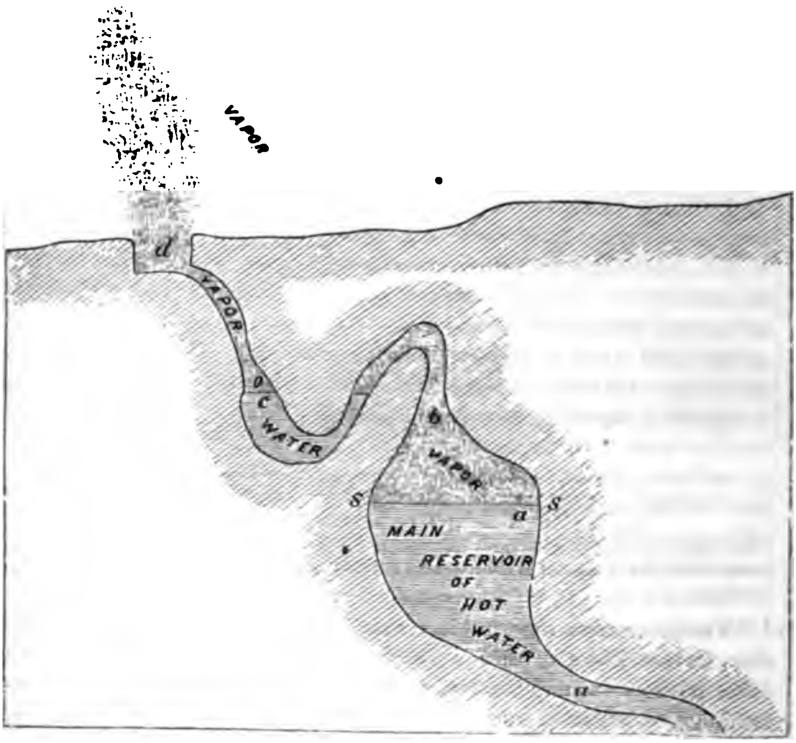


(FIG. 14.) IDEAL SECTION OF A THERMAL ERUPTIVE SPRING.

rrows represent the direction of the action of the subterranean force. The channel is con-
l at *o o*, the entrance of the surface bowl; 1, 2, 3 represent the variable position of the suc-
jets.

'he phenomena observed in connection with the typical geyser, how-
do not admit of such a simple explanation; and there is much
whether existing theories are sufficient to account for all the com-
manifestations of such agitated bowls. Almost without exception,
true geyser, the action, whether frequent or the reverse, is inter-
nt, although the successive periods in each case may be quite irreg-
Usually, as the first indications of an approaching eruption, there
e noticed an escape of vapor, soon followed by a sudden rising of a
of water sufficient to fill the surface-chamber of the geyser. The
mena which follow are very largely the result of structural features
rying nature, no doubt, but it will invariably be found that the
ion takes place near the centre of the bowl, and that the elevation
e column of water is accomplished by continuous or successive
from one spot, while in the ordinary eruptive springs the column
dom shot upward from the same point twice in succession. We

must, therefore, believe that the propelling power in the geyser acts temporarily and suddenly, while in the common hot spring, quiet, boiling, or eruptive, constant or periodical, the force is evolved with considerable regularity. The idea which the writer desires to convey will be rendered more evident by the comparison of Figures 14 and 15. Figure 14 shows the supposed section of a common eruptive spring; and it will readily be seen that jets may even occur in cold springs of this structure, provided a quantity of carbonic acid or other gas is struggling to free itself from beneath the ledge at *o*. In Figure 15, which is intended to represent the supposed condition of the subterranean geyser-waters in the first stage of an eruption, the reservoir *a* is supposed to contain water which remains in equilibrium nearly at the level *ss*. By constant accessions of heat from below, the vacant passage above is finally filled with vapor, and by degrees the water in the bent passage *c* becomes heated, and evolves vapor also, as in *o*. After a time, the expansion of the vapor in *b* is able to overcome the combined pressure of the water and vapor in *c* and *o*, when the latter is forced out, followed by a portion of the water in the reser-



(Fig. 15.) IDEAL SECTION OF AN INTERMITTENT GEYSER.

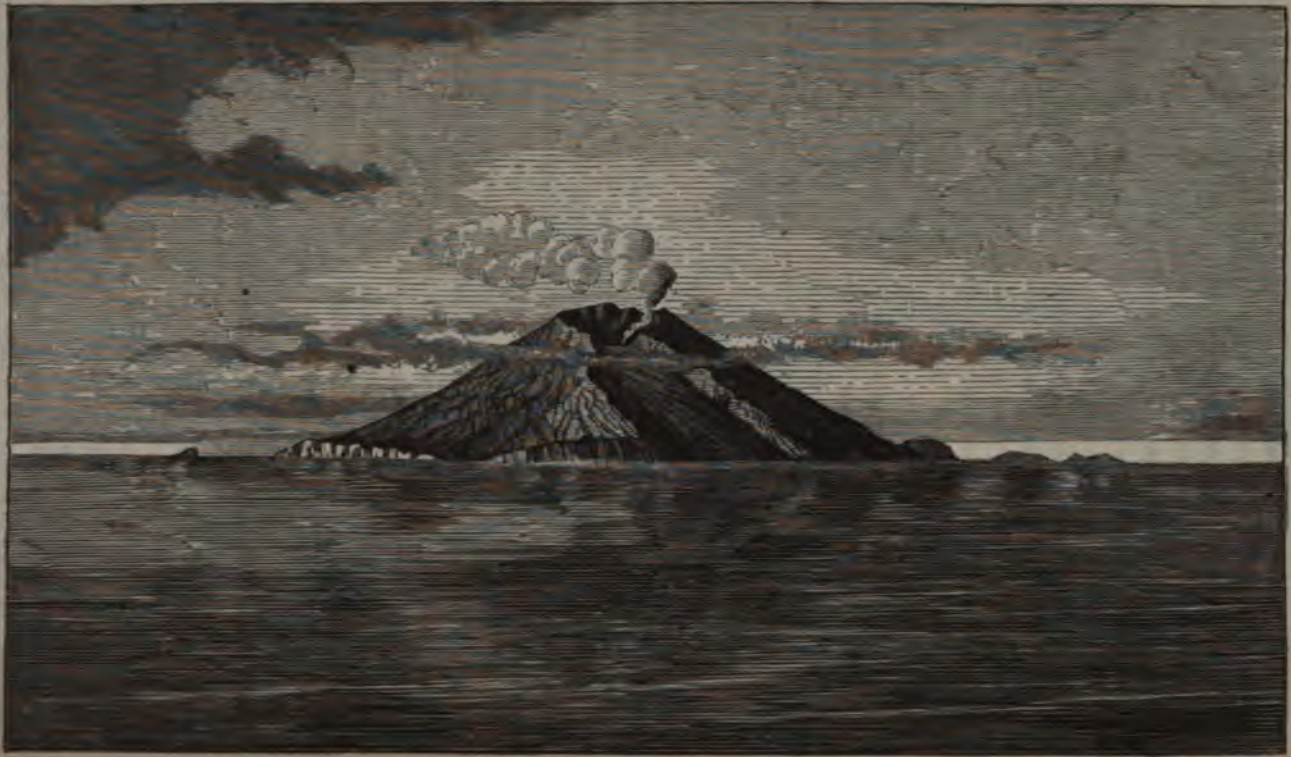
To illustrate the phenomena of eruption during the escape of vapor, prior to the ejection of hot water.

ir *a*. The force thus expended, a vacuum is produced in *b* by the re-
ding of the column of water in *a*, and the foregoing operations are
lefinitely repeated. This theory seems capable of explaining the facts
far as they are known, and the variations observed in special cases, or
en in different eruptions of the same geyser, appear to the writer to
quire but slight modifications of the section, and none that are of great
portance. The passage *c* may be kept filled with water by means of
surplus which falls back into the bowl.

" Bunsen's theory of geyser action, which has not yet been proven inade-
ate to explain the more prominent features of eruptions, does not seem
ficient (to the writer) to account for all the differences between the
ser and the mere hot spring, but it must not be inferred that such ex-
lent authority is disregarded. On the contrary, the author proposes
structural hypothesis simply as a supplement to the superheating
ory of Dr. Bunsen, in order to explain surface phenomena common in
Fire-Nob basins, which appear to require an extension of his views.
the same time it must be confessed that there are objections to his the-
, based upon these observations, which are difficult to reconcile. It
l be impossible to present these here, but an outline of the theories
question is appended. Bunsen has shown that an eruption may be
ficially produced by introducing steam near the base of a long, nar-
column of water, which causes the water, as it rises under pressure,
become super-heated, the surplus heat being used for the production
more steam, which adds to the elevating force. This admirable the-
, of which the above experiment is an illustration, is based upon a
es of ingenious observations among the hot springs of Iceland.
chof adopts an opinion almost identical with the structural hypothesis
e proposed, and the present author, it will be remarked, combines the
theories, believing both necessary to explain all the facts observed."

HE MECHANISM OF STROMBOLI. — As apropos to the subject of gey-
we would direct the reader's attention to an able article on Stromboli
the late G. Poulett Scrope, published in the *Geological Magazine* for
ember, 1874, and illustrated by a view of Stromboli, which is here
roduced (Plate I.) through the courtesy of the publishers, the Messrs.
bner & Co. Mr. Scrope attacks Mallet's suggestion that the mech-
m of Stromboli has not merely some similarity with that of a geyser,
that the volcano actually contains a geyser in its inside. In this con-
ion he quotes Lyell's Principles, in which it is stated that the phe-
ena of geysers "have no small interest as bearing on the probable
hanism of ordinary volcanic eruptions, namely, that the tube itself is
main seat or focus of mechanical force." Scrope then refers to his
theory, which corresponds to the views of Lyell and Dana. The
ion of the latter he quotes as that "of an impartial and unquestionable
ority" (Dana's Manual, 1863, page 692). Mr. Scrope shows that
ere is no ground whatever for attributing to Stromboli any mech-
m different from that of ordinary volcanoes."

PLATE I.



STROMBOLI VIEWED FROM THE NORTH. (*After* Abich.)

'HE MOUNTAINS OF NEW ZEALAND. — In the coast scenery of Zealand, with its deep fiords and mountains, none of which, however, above an elevation of nine or ten thousand feet, we find some insting similarities to the scenic features of the Pacific coast of Oregon Alaska. An interesting account of the physical geography of New land, particularly the province of Otago, is given by Messrs. Hutton Ulrich in their Report on the Geology and Gold Fields of Otago. sounds or fiords were in one case found to be 1728 feet in depth. Hutton notices the points of difference between the Alps of Switzer- and those of New Zealand. "No one," he says, "after visiting Alps of New Zealand, could fail to notice two remarkable points of rence between these mountain regions. The one is that mountains sharp, serrated summits, which are the exception in Switzerland, the rule in New Zealand, and the other is that the numerous large rfalls which the traveler in Switzerland sees at almost every turn quite exceptional in New Zealand. A few waterfalls, but they are few in comparison with Switzerland, are found in the deep fiords he west coast, and a few smaller ones towards the heads of the valleys e heart of the mountains, and these are nearly all. And yet the ntains in New Zealand are quite as rough and rugged as the Alps of ope, and indeed the gorges are more numerous and deeper. There lso other minor points of difference."

GEOGRAPHY AND EXPLORATION.

AMERON'S EXPLORATIONS IN TROPICAL AFRICA. — Cameron's evement stands quite alone. For the first time in the history of world a European traveler has walked across tropical Africa from to west. But Cameron has done more. This wonderful march of e thousand miles is but a portion of his work. He has taken such a s of scientific observations as will place him in the foremost rank of tical geographers; he has surveyed the southern half of the great e Tanganyika, has solved the problem of the course of the Congo, has fixed the position of the water parting between the Congo and Zambesi.

orn in 1844, and having entered the navy in August, 1857, Lieunt Cameron was only twenty-eight when he received his instructions Sir Bartle Frere at Zanzibar, and took command of the Livinge East Coast Expedition. His previous services, which qualified him his important charge, are recorded at page 274 of *Ocean Highways* December, 1872. His instructions, dated February 14, 1873, were ke up supplies to Dr. Livingstone, and to carry out such exploraas he might direct or advise, it being specially pointed out that the pletion of the survey of Lake Tanganyika was work of great imance. Accompanied by his friend and old messmate, Dr. Dillon,

R. N., and by Lieutenant Murphy, R. A., Cameron made a final start from the east coast for the interior on the 18th of March, 1873.

The young lieutenant showed his admirable fitness for the work from the first. There were special and peculiar obstacles which entailed very heavy expenditure, and Dr. Kirk was of opinion that no expedition, starting from Zanzibar, ever had so many difficulties to encounter. Cameron gallantly faced and overcame them, and, in spite of them all, he reached Unyanyembe on the 4th of August, 1873.

At this place all the members of the expedition suffered terribly from illness. Out of forty-five days Cameron himself was down with fever during twenty-nine, and was afterwards prostrated by a still more serious fever, of a remittent type, and inflammation of the eyes. It was here that the faithful servants of Livingstone, bringing with them the remains of the great traveler, and his journals and other effects, joined the relief expedition and received that aid which enabled them to reach the coast. Lieutenant Cameron sent down the Livingstone caravan to the coast, in charge of Lieutenant Murphy, with ample supplies for the journey; and the continued illness of Dr. Dillon obliged him also to return. The party left Unyanyembe on the 9th of November, 1873, and on the 17th, Cameron's friend, Dillon, "a skillful and zealous officer, and a highly accomplished scholar and firm and steadfast friend," succumbed to the effects of overwork and a pestiferous climate.

Cameron was now alone; but his work was not yet done. Livingstone's servants had reported that a most important map belonging to the doctor had been left at Ujiji, without which the record of the great traveler's discoveries would be very incomplete. It seemed to the young explorer that its recovery was a sacred duty, and he also considered himself bound to do his utmost, with the means at his disposal, to further the cause of geographical discovery. With these objects, but still suffering acutely from the effects of fever and ophthalmia, Cameron set out from Unyanyembe for the west on the 11th of November, 1873. He kept on steadily working "westward ho!" with dauntless perseverance, until he reached the shores of the Atlantic.

Traveling through a difficult and entirely new country, he discovered several of the southern tributaries of the Malagarazi and the interesting region they water, and on the 21st of February, 1874, he reached the shores of Lake Tanganyika.

Cameron's first great geographical exploit after reaching Ujiji was the survey of Lake Tanganyika, which he ascertained to be 2754 feet above the level of the sea. He launched his boats in March, 1874, closely examined and surveyed the whole southern half of the lake, discovered the great stream called Lukuga, flowing out of it, and returned to Ujiji on the 9th of May. His invaluable map of the lake will be found facing page 72 of the *Geographical Magazine* for March, 1875, and was also published in the Proceedings of the Royal Geographical Society. Cam-

on has since been informed that Lukuga, the outlet of Lake Tan-
nyika, falls into the Lualaba above the junction of the Lurwa and
e Kamorondo.

The gallant explorer started from Ujiji on his lonely and chivalrous
pedition on the 20th of May, 1874, and, after traversing the Manyuema
untry, arrived at Nyangwé on the Lualaba, the farthest point reached
Livingstone, in the following August. He found that Livingstone
d placed this station ninety miles too far to the west. It proved to be
ly fourteen hundred feet above the level of the sea, which at once puts
end to any notion of the Lualaba being connected with the Nile sys-
n. Instead of flowing north, the Lualaba here turns to the west, and
n west-southwest, eventually entering and flowing through a great
e called Sankowa. The river receives many tributaries from the
th, and one very large stream from north of the equator, called the
wa. Thus the drainage from both north and south of the equator
ounts for the two rises in the Congo. For Cameron has now fully
ablished the identity of the Lualaba and the Congo.

The advance from Nyangwé, Livingstone's farthest point, was the
st momentous crisis in Cameron's undertaking. The difficulties were
at. It was impossible to obtain canoes. The chief beyond the Lo-
né, which here falls into the Lualaba, declared his resolution of mak-
war if the explorer attempted to cross his country. He was thus
erted from his intended route down the course of the Congo. But
was not to be stopped. The route he actually did take was of equal
ortance, and led to equally valuable geographical discoveries. It led
h from Nyangwé, up the eastern side of the valley of the Lomané,
Kilemby, the capital of a great chief named Kasongo, who ruled over
the country of Urua.

he Urua country was first made known to us by Captain Burton, in
Lake Regions of Central Equatorial Africa, who calls it Uruwwa,
central district west of Tanganyika," with a ruler named Kiyombo,
was friendly to the Arabs, and traded in ivory, staves, and copper
Katanga. Dr. Livingstone also heard of the same country, which
called Rua; but Cameron was the first to discover it and fix its
tion.

ameron remained at the capital of Urua from October, 1874, to Feb-
y, 1875. It is a most important central point, for here the traders
the east and west meet. Cameron found an Arab merchant named
ah ibn Salim, from Zanzibar, and also two mulatto traders named
z and Coimbra, from Bihé in Benguela. His long detention in
ongo's country enabled the explorer to collect much valuable geo-
hical information respecting the whole of this part of tropical Africa,
ding a complete and detailed account of the rivers and lakes which
the Congo from the south. He discovered a new lake called Kas-
through which the Lualaba flows; and another, with no outlet,

called Möhoya, which is specially interesting from having regular lake villages on its waters. He discovered also that the Lomané is a distinct river from the Kassabé, receiving a large stream called Luwembi from the west, coming from a lake called Iki, probably the Lake Lincoln of Livingstone. Katanga, the famous copper-yielding district, within the territory of Urua, is situated between the rivers Lualaba and Lufira, which unite, and the combined stream, after flowing through a chain of small lakes, receives the Lualaba of Livingstone, which is really the Lurwa. The united rivers then flow through Lake Lanji (the Ulengé of Livingstone), and past Nyangwé to Lake Sankowa, and thence, as the Congo, to the sea. Cameron ascertained the names and positions of all the different tributaries of these rivers, and will be able to give a complete account of the hydrography of this newly-discovered region of the Upper Congo.

After many vexatious delays, Cameron, accompanied by the mulatto Alriz, set out from Kasongo's country for Benguela. His course led him past the sources of the Lomané and the Luwembi, and close to the sources of the Lulua he came upon water flowing to the Zambesi. He traveled over a rich table-land, with numerous streams, to Sha-Kilembe's town, which he reached in September. The nights were cool on this elevated plateau, and on two occasions there was actually frost, when Cameron enjoyed the feeling of the crisp soil crunching under his feet. Sha-Kilembe is the Ya-Quilem of Ladislaus Magyar. It is on the river Lumèji, a tributary of the Liambeje, in latitude 11° 31′ south and longitude 20° 24′ east.

As the travel-worn party approached the goal, all nearly spent, and with supplies at the lowest ebb, their leader performed an additional journey of a hundred and twenty geographical miles, in order to bring assistance to his native followers. The route led from Sha-Kilembe to Bihé, and thence to the Portuguese town of Benguela, on the shores of the Atlantic, where Cameron arrived last October, and whence he proceeded to Loanda to recruit his health. Thanks to the forethought of the Viscount Duprat, the great traveler received every attention and much kindness from the Portuguese officials. As soon as he has found means of sending his other followers to Zanzibar, he will return home with old Bombay, the veteran servant of former travelers, and a small boy named Jacko, who accompanied him from Unyanyembe.

When Cameron arrives in this country, and fills in the details of the mere skeleton route which is now before us, we shall have a story of unsurpassed interest, whether we consider the great geographical discoveries he has made, the new regions he will describe, or the personal narrative of the intrepid sailor himself.

But Cameron's extraordinary merit rests mainly on the number and value of his scientific observations. The total distance over which he has marched from Zanzibar to Benguela is 2953 miles. Along this

ute he has fixed 85 positions and taken 706 observations, consisting
137 for latitude by stars north and south of the zenith, 196 for time,
8 lunar observations, one for the sun's eclipse of April 6, 1875, and
r amplitudes for compass variation. His method of observing lunars
longitude is of the first order, namely, by stars east and west of the
on's enlightened limb; and by computing his observations, he has not
ly laid down his route accurately, but has also projected a remarkable
tion of the country over which he traveled, from the Indian Ocean
the Atlantic. The heights of places above the sea are determined by
r Casella's aneroids, including 3718 observations, and by 70 observations
five boiling-point thermometers. The itinerary gives the approximate
tude and longitude of all the places visited, and their distances from
h other; and by this itinerary, with the observations for height, the
tion sheets have been projected. Cameron also collected a vocabulary
the language of interior Africa, comprising fourteen hundred words.

The vast importance of Cameron's discoveries, which establish on a
basis the geography of south tropical Africa, cannot be fully appre-
ed and understood without a carefully prepared map accompanied
a critical commentary, which will be published in our number for
rch. Meanwhile we may look for the return to this country of the
t traveler himself, where he will receive a hearty and cordial wel-
ne.

But Cameron himself has abstained from laying any claim to theoret-
or hypothetical discoveries, and has merely stated facts that have
e under his observation, and the reports he has collected from Arabs
natives. He has never claimed the discovery of the outlet to Lake
ganyika. He has simply described a stream, called the Lukuga,
ch he found to be flowing out of the lake, and the course of which
followed for four miles. He leaves deductions to geographers at
e, while he furnishes them with accurate data for forming their con-
ions. It is Burton who has generously called his young successor
second discoverer of Tanganyika." Cameron's observations are
complete than those of any previous traveler, but he speaks with
acteristic modesty of his discoveries. "As for geographical work,"
ys, "I have cleared up a lot of mistiness, if not positive darkness;
the work is immense, and ought to be taken in hand thoroughly, and
y desultory expeditions which make their way to one point, and then
to come away with their work unfinished. Fresh men should take
e work of their predecessors, instead of, as at present, every man
g to hunt for his own needle in his own bundle of hay." If all
lers worked and observed as Cameron has done, there would be
left to desire. — *Extracted from The Geographical Magazine for
uary.*

MICROSCOPY.[1]

Mode of Production of Microscopical Images. — Professor Abbe, of Jena, has lately[2] established a conception of the manner by which images are produced in the microscope, which is entirely different from those usually adopted. The microscopical image of the object is formed by the superposition of two images, which have an entirely different origin, and can in fact be conceived to be separated one from the other. One image is a *negative* one, by which all parts are represented as a geometrical likeness by the unequal emersion of the rays of light passing through the object. This image is called by Abbe "absorption image." It represents the *definition* of the microscope.

The other image (formed by as many partial images as there are bundles of rays which have been isolated from the cone of light, and pass into the object) is *positive*. It is an image produced by refraction, and represents the *penetration*, that is, the finer structure of the object. Wherever the structural elements of the object are small enough and approximated enough, phenomena of diffraction appear. The consequence is that structural images, produced by a coöperation of the fraction of the rays of light, are not in a constant connection with the real structure of the object which produced it, but in constant connection with the phenomenon of diffraction which brought about the image.

Microscopical images, therefore, showing systems of fine lines, as in diatoms, do not allow us to infer with safety the morphological existence of such structures, but only the existence of structures necessary to bring about such images. Consequently, the smaller the linear dimensions of a structure, the more unsafe are the conclusions respecting the real structure as indicated by the image. It can therefore never be decided with certainty by what sort of structure the systems of lines (as for instance those of *Pleurosigma angulatum*) are produced, nor will the image of the finer transverse lines of muscular fibres give certain conclusions about the arrangement of the finer details of structure. This want of certainty may also apply to differences in the degree of transparence of objects, their color and polarization.

Abbe's researches allow us to limit with certainty the powers of the microscope. "Never can parts be seen which are so nearly approximated that even the first bundles of rays of light produced by fraction are not able to enter the objective at the same time as the unbroken cone of light." Every aperture of the objective has a fixed limit for the smallest distance of objects by which it is possible to see the object.

Any new perfection of the microscope cannot go much further than to show for central illumination the whole length of one wave of blue light, and for the greatest possible oblique illumination half the length of a wave.

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[1] This department is conducted by Dr. R. H. Ward, Troy, N. Y.

[2] Archiv für mikroskopische Anatomie, 1873, ix. 413–468.

It may therefore be observed that no microscope will show any more f the structure of an object than it is possible to see by an immersion-bjective of a power of two hundred diameters. Helmholtz[1] arrives at e same results by another mode, giving the smallest perceptible disnces for the middle greenish yellow light, 0.000275 mill. = $\frac{1}{3636}$ mill. - H. HAGEN.

[We print this abstract of Professor Abbe's curious researches, though ot without mental reservations in regard to some of its conclusions. — D.]

TYNDALL ASSOCIATION. — The second annual "Science Exposition" this active society was given at the City Hall, Columbus, on the enings of December 7, 8, 9, and 10, 1875. A prominent part of the hibition was the microscopy, in charge of the president of the microopical section of the society, Rev. I. F. Stidham. Objects calculated prove attractive to a popular assemblage were displayed upon microopes furnished mostly by the members of the society, and an explanary lecture was delivered on the first evening by Prof. A. H. Tuttle. he instruments, over thirty in number, were by nearly all the familiar akers, the following maufacturers being those that were represented by ore than one each: Beck, Queen, Hartnack, Grunow, Ross, Zentayer, Crouch, and Fields.

SONOROUS SAND. — The "musical beaches" which occur at some points the New England coast and in Georgia, as well as at the more nous localities in Arabia, Switzerland, the Hebrides, and the Sandch Islands, have lately been attracting much attention from microopists. When handfuls or larger quantities of the sand are rubbed gether, a musical sound is produced which seems to be due to the nurous microscopic pits or cavities which abound in the grains of sand. ese pits are especially conspicuous and interesting in the Sandwich ands sand. Moisture, which would temporarily obliterate the cavities, events the sound.

EXCHANGES. — A photograph of any specially interesting microscopic ject will be furnished in exchange for the use of the object from ich to obtain a negative. The object itself will be returned uninjured thin one week. Address proposals to R. H. Bliven, Elmore, Ohio. — uble-stained vegetable sections in exchange for good mounted objects G. C., 103 Warren Avenue, Boston. — Slides of sonorous sand m Sandwich Islands in exchange for any good mounted objects. W. C., 103 Warren Avenue, Boston.

UNMOUNTED OBJECTS. — C. A. Baldwin has transferred the agency distributing these objects to Prof. H. A. Ward's museum, Rochester, Y., from which they can be obtained in future.

J. W. QUEEN & Co. — The changes recently noticed in this firm re- only to the New York house.

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[1] Ueber die Grenzen der Leistungsfähigkeit der Mikroskop, Monatsberichte der lin Akademie, 1873, page 625.

SCIENTIFIC NEWS.

— The annual report of the trustees of the Museum of Comparative Zoölogy contains plans of the museum building, with a view of the wing, now partly built, together with its proposed addition and the cornerpiece joining it to the main building. The curator, Mr. Alexander Agassiz, seems to discourage the accumulation of great stores of alcoholic specimens, suggesting that they should be restricted to a minimum, and limited, as far as possible, to those classes where no other mode of preservation is practicable; and he thinks "the time has come when large collections must naturally be supplemented by zoölogical stations. These, when once established at properly selected localities, will enable museums to dispense with much that is now exceedingly costly." By the success of the Agassiz Memorial Fund, the authorities will be enabled, as soon as the contemplated additions to the museum are erected, to carry out the principal ideas of Professor Agassiz for the arrangement of a museum. This fund is stated to amount to $310,673.99.

— A new marine Fucoid from the Water Lime Group, at Buffalo. N. Y., has been noticed by Messrs. Grote and Pitt, under the name of *Buthotrephis Lesquereuxi*. The specimen is one of the best preserved of the kind yet discovered. No remains of sea-weeds appear to have been known hitherto from the Water Lime Group of the Silurian formation.

— The third volume of the new edition of the Encyclopædia Britannica, just published, contains articles on the Atlantic and Baltic, by Dr. W. B. Carpenter, and on Biology, by Professor Huxley and W. T. F. Dyer.

— The *Progress of Darwinism* is an annual issued in Germany, giving the annual record of evolution literature, as part of a series of other reports on the progress of geology, meteorology, etc.

— Among the recent books of travel published by E. H. Mayer, Cologne and Leipzig, are the three following, by Robert von Schlagintweit: Die Prairien des amerikanischen Westens (The Prairies of Western America); Die Pacific-Eisenbahn in Nordamerika (The Pacific Railroad of North America); and Die Mormonen, oder die Heiligen vom jüngsten Tage (The Mormons, or Latter-Day Saints).

— A summer school of science and physical culture on a rather novel plan is projected by Prof. D. S. Jordan, who proposes to take a class of twenty on a march from Indianapolis to the upper waters of the Tennessee, thence by boats down the French Broad and Tennessee, to Chattanooga, where the school will be closed.

— A memoir of the late I. A. Lapham, LL. D., who suggested the U. S. Weather Signal System, has been prepared by Mr. S. S. Sherman.

— Élisée Reclus is editing Nouvelle Géographie universelle, la Terre et les Hommes, of which six livraisons had appeared in Paris up to November last.

PROCEEDINGS OF SOCIETIES.

ACADEMY OF NATURAL SCIENCES, Philadelphia. — February 24th. rofessor Cope gave a history of the progress of the doctrine of evolu- on of animal and vegetable types. (This is printed elsewhere in this mber of the NATURALIST.) Dr. Allen called attention to a remark- ly prognathous human skull, from Australia, belonging to the academy, which the monkey-like characters were unusually apparent. Other culiarities observable only by anatomical experts were pointed out. paper by Dr. Charles A. White, entitled Descriptions of Fossils from lœozoic Rocks of Iowa was presented for publication.

ACADEMY OF SCIENCE, St. Louis. — February 7th. Prof. C. V. Riley narked on insectivorous plants, stating that while *Drosera*, *Dionæa*, ., actually digest animal matter, the only benefit *Sarracenia* received m captured insects was from the liquid manure resulting from their trescent bodies.

SOCIETY OF NATURAL HISTORY, Boston. — February 16th. Prof. illiam B. Rogers presented some geological notes on the thickness of Virginia Tertiaries as indicated by the artesian borings at Fortress nroe; on the Upper Secondary Sandstone of Virginia as including ancient drift, and its relation to the post-tertiary cobble-stone deposit; h suggestions in explanation of the course assumed by all the great ers of the Middle States on entering the region of tide-water.

rofessor W. G. Farlow remarked on the nature and mode of growth the "black knot" of plum and cherry trees. This is an American gus, and has spread from our wild plums and cherries to the cultivated s. Professor Farlow recommended the wholesale destruction of our l species, especially *Prunus Virginiana*, as breeders of the disease, ch, if followed up by careful pruning of trees in cultivation, could not finally to eradicate the black knot.

AMBRIDGE ENTOMOLOGICAL CLUB. — January 14th. It was voted a publication fund should be established, amounting to at least two usand dollars, the interest of which should be expended in publishing *che*, as in no other way would it be possible to maintain the publi- on of the Bibliographical Record of North American Entomology, ch is already recognized as more complete than any other similar rd of any department of science. A committee was appointed to in this fund.

r. Scudder pointed out the presence of some hitherto unparalleled ds in the thorax of *Anisomorpha buprestoides*, and presented a paper the subject for publication in *Psyche*.

r. J. H. Stebbins, Jr., mentioned the capture, near London, of a *ilio Machaon* which had five wings. The specimen is now in the ish Museum.

bruary 11th. Mr. Scudder said that he considered that Mr. Riley had proved by his recent investigations that *Megathymus yuccæ* is a butterfly, and forms a new group of Urbicolæ.

Mr. Scudder exhibited a dissection of *Autolyca pallidicornis*, to show the interior glands corresponding to the prothoracic excretory openings to which he had called attention at the previous meeting, when speaking of the function of these organs in *Anisomorpha buprestoides* (*Spectrum bivittatum*) and in Phasmidæ generally.

Mr. Fewkes exhibited drawings to show the structure and position of these glands. Mr. Dimmock exhibited wings of Microlepidoptera which had been bleached and mounted as microscopic objects; some of these had been colored after bleaching, so as to show that the scales still remained.

Troy Scientific Association. — February 21st. Wm. E. Hagen read a paper on the curiosities of gold and gold mining, giving prominence to those facts that might have given plausibility to the theory of the derivative character of this metal. An abstract of this paper will be published in another number of this journal.

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SCIENTIFIC SERIALS.[1]

The Annals and Magazine of Natural History. — January. On the Classification of Scorpions, by T. Thorell. First Report of the Naturalist accompanying the Transit of Venus Expedition to Kerguelen's Island in 1874 (conclusion), by A. E. Eaton.

Monthly Microscopical Journal. — February. Remarks on the Foraminifera, with especial Reference to their Variability of Form, illustrated by the Cristellarians, by T. Rupert Jones.

The Geographical Magazine. — January. The Swedish Arctic Expedition. The Malayan Peninsula, by H. St. John. On former Physical Aspects of the Caspian, by H. Wood. Is it Possible to Unite the Black Sea and the Caspian? by D. Ker. The Western Sahara, by E. G. Ravenstein (with a map). February. Dr. Beccari's Recent Visit to New Guinea, by H. H. Giglioli.

American Journal of Science. — March. Structure of *Obolella chromatica*, by E. Billings. On the Damming of Streams by Drift Ice during the Melting of the great Glacier, by J. D. Dana. On Flint Implements from the Stratified Drift of Richmond, Va., by C. M. Wallace. Principal Characters of the Tillodontia, by O. C. Marsh.

The Geological Magazine. — February. Sketch of the Geology of Ice and Bell Sounds, Spitzbergen, by A. E. Nordenskiöld. Remarks on the New Hebrides Group, by H. Hosken.

Nature. — January 27th, and February 3d. Professor Tyndall on Germs. Professor Nordenskiöld on the Jenisei.

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[1] The articles enumerated under this head will be for the most part selected.

THE

AMERICAN NATURALIST.

Vol. x. — MAY, 1876. — No. 5.

ANIMAL HUMOR.

BY REV. SAMUEL LOCKWOOD, PH. D.

> "The heart is hard . . . that is not pleased
> With sight of animals enjoying life,
> Nor feels their happiness augment his own."

HAT deep philosophy might be evolved from an honest contemplation of animal sports! Just here a child may turn echist, to the confusion of the wise man. Whether well or erwise, Cowper's words have been allowed to push us into the n. He gave us our first draught of literary humor. It was g ago, but it comes up to-day as a delicious vision. The first m that made our almost baby cheeks to dimple with ringing ghter was John Gilpin; and when told that its author kept e pet hares, Puss, Tiney, and Bess, in our boyish estimate became at once a right proper man. And the later judgment firms the youthful verdict. It has seemed to me that it is animals much as it is with other folks; the jocose and the etic, the gleesome and the sad, are very often from the same k born. There is a rough-and-tumble mirth, enjoyed alike logs and boys, yea, and those semi-barbarous ones denomi- d "roughs." It is observable of this kind of play, with both dogs and the urchins, that, however high their glee, a small g will put out all the fun. A decayed apple rightly thrown ten sufficient for this purpose: the whole effervescence is over, the fun is flat as stagnant water.

the departed days when one chair in college took several gies," our good old "Prof." was a very funny man. He was sely practical. His jokes, even, were kept in stock and cal- red; each had its own time and purpose. There was his r joke," always pronounced "huge and capital." This bit it, with stately introduction, was regularly aired in sopho- year. A wicked junior informed us just when to expect it. g now no longer fresh and green, it was resolved in class

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caucus that we would conduct ourselves as behooved philosophers, when this laughter-provoker should make its annual round. At the expected time it came, and was really excellent. The professor let it off in good style; then he laughed heartily at his own wit. And why not? He had done so annually for a generation of years. But, alack! nobody joined in the chorus! Such a refrain! It was unanimous. The class were as demure as a pack of wearied mules. Every face was stolidly, starkly blank. As a humorist, that rotten apple had "put a head" on that learned man. Whether this cruel shock had caused the lesion of some nervous centre was not known, but we never heard the professor joke or laugh in class again. Ever after, the humanities were dispensed very dry, and ethics, his forte, were especially served up quite plain. Sorry for our naughtiness, we came to regard our action as a second-class joke.

Within hailing distance of our former home at Keyport was the shop of a basket-maker. A pet monkey was the occasion of many an uproarious scene in the shop. In fact, all hands sometimes played monkey, the quadrumanal leading off, hunted by the bimanal ones, over and through the sinuosities of great heaps of oyster baskets. Unaware of our seeming pedantry, we ventured to say that the specimen belonged to the family *Cebidæ;* this was promptly corrected by an apprentice, who told us that it belonged to the "boss's family." Happily, we were both right. It was one of the spider monkeys, and known as *Ateles Belzebuth.* "The devil it is," said the apprentice. "You bet, there's deviltry enough in that monkey." To this we condescended no reply, regarding it as a little profane, and a good deal libelous. We continued by saying that the monkey came from South America, where they called it the "marimonda." Again came an interruption from the facetious apprentice, who said, "There *is* a heap of mountebank in the little cuss." The wee thing was a slim-bodied, long-limbed, and grotesque-looking creature, and withal gentle, and confiding, and brimming over with fun. It was quite fond of a good-natured romp with the men and boys, when it would jump from one to the other, and cast around their necks that marvelous fifth hand, its prehensile tail. In tit-for-tat, tag-and-run, its agility and tactics were splendid. All this was very fine for a few days. But this good-natured romping soon became ill-tempered and vicious on the part of the shop hands. In truth, erelong that sense of feeling tired set in which so soon comes upon many an owner of

ts. Then came heartless practical jokes, harsh treatment, and
neral neglect. The poor creature had now evidently lost all
art. Something worse than the throwing of the rotten apple
d happened. Marimonda was clever at catching sticks. A hot
ker was thrown to it, — the burning shame! Poor thing! It
w broke down completely, and made up its mind to drop all
n forever. Not at all vicious, still gentle, but joyless, it be-
me chronically sad. Prematurely grave, for it was very young,
e merry Marimonda was mirthful no more. I told its tor-
entors that the little fellow's days were numbered; in fact, that
ey were killing it. Already it had lost confidence in every
e of them; but the first time that Ateles heard my voice, it
proached me with a trustingness which was quite affecting. It
tracted the attention of the workmen, one of whom said, "Just
k at that! The beast won't come nigh any of us, and always
rs a stranger; but see how it takes to the minister from the
st time that it puts eyes on him. It fairly whimpers when it
ars him coming." All this was true. And for that whimper —
was a plaintive coo, soft and flute-like. True it was, whenever
called at the basket-maker's shop I was sure to be met with
e love-greeting of little Ateles, a soft, cooing utterance of
stful joy. But there was much plaintful, tender melancholy
it, for the wonted merry mood of Marimonda was forever gone.
at there was real affection in that little heart, I entertain no
ubt. Its gentle eyes told all this plainly whenever they saw
coming. Such manifestations could not be other than touch-
, they spoke so unmistakably of an implicit faith in me; and
is evident that it yielded the fruits of peace to the trusting
. I think with animals, as with men, humor and gentleness
together; and if either survive the other, it is this goodness
t gleams when the other light is put out.

I would not have it implied that this glinting towards, or even
imilating, the higher attributes of man makes our monkey less
ian, but I would insist that such qualities should not be reck-
d brutish. It is these touches of nature that make the whole
rld kin. I never dared interpret the words of that apostolic
n, words so weighty with significance, whatever that may be,
every thoughtful mind: "For we know that the whole crea-
n groaneth, waiting for the adoption." Yes, trust is needed at
dark end of the journey. I have had a mouse creep into my
d to be covered, and to die.

Poor Marimonda soon came to grief. A pot of green paint unintentionally set in the way proved too much for simian curiosity. She ate of the pigment, and in pitiful agony perished. This was dolorous tidings to us, and our temper rose to a spurt of indignation. Ah well, our soul contains no green-room secrets, so it may as well be confessed: it did make our placid spirits rily to see our pet comique go off like a contemptible Doryphora, dosed with Paris green.

Shall not proper names be respected? And were not James and John apostles? How then could our learned friend ever again speak in meeting after that irreverent pun of calling his two monkeys, Jack and Jim, "the sons of Cebidæ"? But there are some things that common folks cannot cope with. Once happening in upon our savant friend, we made the acquaintance of Jack, who now was alone. As his master said, Jack was a *Cebus*, and his proper name was *Cebus capucinus;* hence he was a cousin, so to speak, of our Ateles, as they both belonged to the same family, *Cebidæ.* I suppose that *capucinus* would indicate that this *Cebus* had a monkish head on his shoulders. Though very much more demonstrative, Jack had not the winning ways of Marimonda. His accomplishments were in another line. While the voice of Ateles was soft and musical, and in general her actions were gentle, Jack abounded in guttural gibberings and genuine monkey grimace. I had never before seen Jack, nor indeed, except the one fact of his remarkable sonship, had I even heard of him. When I entered the house he was chattering in his cage. I approached and said, "Poor Jack!" at the same time extending to him both my hands. He took a finger of each hand of mine into each of his tiny hands, and as he held me thus, he gazed into my eyes as a discerner of spirits might who is divining from the tone of voice and the light of the soul-windows. The query in Jack's mind was, "What sort of stuff is this new fellow made of?" Mental movements are sometimes miraculously quick, and that monkey's mind was made up like a flash. The savant looked on in surprise. "You are the only one," said he, "that Jack has taken a liking to at the first glance." Of a sudden my host set up a terrible to-do, as if he would have me torn to pieces, crying, "Go for him, Jack! Go for him!" But Jack looked perplexed, as he evidently liked me. He still held me by a finger of each hand; and it was plain that he would rather go *for* me, than *go* for me. Again, however, the master shouted excitedly, "*Go* for him, Jack! *go* for him!" And Jack, in obedience to command, *went* for me, shaking my nds by the one finger of each as if he would impress me with e fearfulness of simian anger. And how wide open he kept s mouth, and how the white teeth shone, as from between shed a torrent of gibbering rage! Now this perfunctory tem-st was exceedingly well gotten up, considering the shortness of e notice. The part was well acted; the best make-believe ger I ever beheld. Of course it was the sheerest sham. The ature would not hurt a hair of my head. His owner's com-nds obeyed, he turned his attention to me from a friendly int of view, and began making a minute inspection of my hands, ecially the lines in the palms, as if he might be practicing mistry, he looked so grotesquely grave.

Jack could catch, with either hand, a nut when thrown to him, l crack it with a stone as deftly as any one. He had his ience once sorely tried with an obdurate black walnut. His tress put a large stone in his reach. It was so heavy that k had to walk nearly upright in order to keep his balance en he sought to carry it; but he succeeded, and down, with nicest aim, came the stone upon the nut, which was fairly shed. But if you would evoke the animal's genius, it was necessary to tantalize him a little by putting nuts on the r at an inconvenient distance from his cage. With a doubled ng he would throw the loop, and lasso in the prize. We have him attain his object by the most persistent and ingenious ements of an awkward angular bit of pine wood.

n one occasion a gentleman called who was bald. Our Cebus rded the visitor with unfriendly wonder. Why should he be like him than other folks were? Had not other men, like keys, hair upon their heads? Was not this making an in-us distinction, perhaps to the disadvantage of capucinus? ourse, no son of Cebidæ could say, "Go up, thou bald head!" Cebus was in no reverent mood, albeit he did show off his nplishments in the line of getting the nuts off the floor. He next ordered to *go* for the gentleman, which order he exe-l with alacrity and spirit. As Cebus was securely confined, paroxysm of obedience hurt no one. "But," said the gen-an, as he turned his back upon the cage to address his host, hink his dexterity with that stick is wonderful, and shows capable of even stranger developments." The gentleman orrect; and whether the droll beast was affected by the com-nt or not, we cannot say. It was an inexplicable incident, ver, that at that especial moment the angular wand was brought down with intense simian anger upon that glistening pate. It did look as if Cebus thought, "Let me 'put a head on' that flattery!" The gentleman's feelings may be judged from his actions. Up rose a livid spot, on which, like a soothing poultice, one hand was tenderly placed, as old Uncle Ned would say, —

"In de place whar de wool ought to grow."

Now in all this we find incongruousness and surprise, and, to the spectator, sparkling, rollicking fun. In words, it would have the startle and unexpectedness of wit; in pantomime, that scene would bring down the house like a hurricane. Is it supposable that Jack was unconscious of the fun? I do not think that he was altogether funnier than he knew.

Is it not noteworthy that the fun of animals is chiefly got at in sham battles, amid the roar of mock anger? Boys too often love to tease and worry animals, and not less one another. It is with the same impulse one ties a tin utensil to a cur's tail, or pins some annoyance on a playmate's back; and from the same source come tripping, and sparring, and knocking the hat down over its owner's eyes. If motive be the gauge, how fine the line between much of boyish roguery and monkey mischief generally. Ateles played tag, and Cebus attacked our humble self in fun and the bald man in earnest. On the doctrine of identity, our illiterate neighbor spoke more astutely than he supposed when he bade a teasing wag not to cut up any more monkey-didos with him.

Have we not seen in some men a humor of an inhuman sort, the delight in torment and destruction? Some one has called it "pure cussedness." Mixed with better traits, Cebus had this malady in streaks. He got loose once, and found his way to the closet of confections. A few minutes sufficed him to eat to satiety; then the "pure cussedness" began to play. He took the precious sweets from the jars and threw them on the papered walls of the drawing-room. Oh, was not this the very delectation of fun? "A melancholy scene," did you say? It was Miltonian: "Delectable both to behold and taste." Then came the smashing of glass and china, a most exciting perfomance. The scene of operations was now changed to the museum and study of the naturalist. Here he discovered a rich and novel field for the exercise of his peculiar talents. An aquarium contained a number of living salamanders. Cebus began an investigation. He is quite curious about live things. If in the present instance vivisection was intended, it was very bunglingly done. Each one was taken out of the water, separately examined, its head

ken off, and head and body laid on the floor. Jack had now
ad a tearing time. The mischief done seemed to be to his
eart's content, so he slunk back to the shelf in his cage, on
hich he sat, and looked the very image of demure and passive
armlessness. We find here a humor of a grim and brutal sort,
nseless and wanton, — as when the vicious boy who had badly
urned a cat was asked his reason, and said, " Oh, I don't know.
nly just for fun. I did n't mean anything." Human conduct
bounds in this meaningless deviltry. Maybe this ogreish humor
a phase of that total depravity belonging alike to beasts and
en.

But for striking contrasts of fun and gravity, commend us to
ur young dog, Dick. On his mother's side he came from a
gh-bred stirps; of his father we know nothing. When Dick
t about a frolic, all his powers were enlisted for the occa-
on. In the truest sense he gave his whole mind to it. At
ake-believe anger no canine actor could excel, and I have not
itnessed his equal. I have seen him fly at his mistress, whom
loved with all the ardor of a devotee, as if the very furies
npelled him. He would take her bare arm into his mouth and
owl with the seeming ferocity of a Cerberus. Indeed, the sav-
ery of that growl was one of the high colors in the picture.
ad Dick been homo instead of canis, his histrionic rôle would
rely have been a buccaneer, bandit, or some such marauding
an of blood. No stage-strutting hero could roll his gutturals
ore fearfully. A stranger entering during one of Dick's tragedy
s would have thought his mistress a doomed woman. Make
lieve mad? Why, Dick would simulate "the very torrent,
mpest, and whirlwind of passion," and all in the merest fun,
nply a doggish joke, for when the splurge was over, not the
ast mark would there be on my lady's imperiled limb. I have
ore than once seen this animal in real rage, but it was mild
mpared to the apparent anger of these sham outbursts. And
ck would let off some merry jets of doggish humor. When
couraged to do so, he would laugh, and so droll were these
nine cachinnations, that they would set the household in a
ar. He would also stand up at the table, and, when told,
uld make a feint at a baby cry for a morsel of meat, which
s very ludicrous. And, what was very strange, he could off-
the wildest frolic with the staidest sedateness of conduct.
could turn on the instant from the comical to the grave. As
sometimes found, this very gravity was to us decidedly annoy-

ing and inconvenient. If permitted to accompany me on a village stroll, he would walk behind with the deportment of a footman of the olden time; but let a dog come along and look askance at his master, especially let his tail come in contact with him, however accidental it might be; it made no matter about the size of the offender; if Dick was small he was spry and wiry, and generally the chastisement he administered was short, sharp, and decisive. If it were a large dog, Dick would attack him scientifically. He was agile as a deer. If the subject for correction was one of the heavy weights, Dick would spring into the air, and, descending upon him, inflict a bite in some unexpected place, his complicated tactics and rapid evolutions begetting in the mind of the burlier beast a perplexity like that of the Iron Duke when he beheld the strategy of the little Corsican: "Hang the fellow! he fights contrary to rule!" Dick's solicitous attention to his master's personal welfare, though in spirit admirable, through his way of doing it had become to a degree oppressive, as the minister's good name was now associated with some notable canine contests. What would you think of the town *Chronicle's* going out of its way to wind up a dissertation on Village Dog-Fights thus: "As regards this well-fought contest between the expressman's big dog, Whitey, and the little Dominie in black, all must admire the dogged valor which gave victory to the latter, and sent the former from the field with a sad curtailment of his high prestige; and we cannot but compliment the professional gentleman on his being possessed of so large an amount of fighting capital, as the outcome of so small an investment in dog-flesh. The next time the little Dominie in black goes in, in the language of Lord Macaulay's old Roman, 'may we be there to see.'" Of course such ethical whisperings from so immaculate a source as the public press must be heeded. Having occasion to go to the railroad depot, we took the precaution to shut Dick up. But love laughs at locksmiths. Dick was at the depot as soon as his master, and occupying his usual place behind him. On came the train. A village mongrel, notorious for its habit of following horses and barking at them, came yelping defiantly at the iron horse. We stood waiting for the train to stop; this done, the bully dog retraced his steps to the platform, his tail wagging, expressive of approbation of his treatment of the great fire-fiend. It was evident that Dick, who had kept close to my side, viewed the whole performance with honest but intense disgust. Generally, dogs take to us instinctively;

ey seem to know that we like them; I have almost wondered
the genius of their race has not heard us quoting, "I am the
iend of dogs, for they are honest creatures." However that
ay be, the bully dog approached us and looked as if claiming
r approval of his conduct. To Dick this seemed sheer impu-
nce, and an imposition on his master's good nature which on
s part should not be allowed to go unpunished. The bully dog
as the larger, and stood his ground well for a few moments,
t the punishment Dick administered was very severe, and Sir
fty withdrew in a very humble mood. Our efforts to take
ck off were of no avail. He would never leave a job unfin-
ed. To our astonishment and disgust we heard the compli-
nt from the crowd, "Good for the little Dominie in black!"
w, as the words dominie and clergyman are in these parts con-
rtible terms, the minister naturally felt this to be a slur of an
pleasant personal character.

With all his accomplishments, Dick is quite a young dog, but
an early age he gave us a manifestation of a very touching
ture; if it had been in a child it would have been called filial;
h as know the least about it will, as is the wont, probably call
nstinct. The dog had been engaged in a very hearty, rough-
l-tumble game with our youngest boy, on the kitchen floor;
s gave Dick a decided advantage, and he made the best of it.
this juncture, old Maje, blind and decrepit with age, began
ining at the door to go out for his daily airing. The day was
y cold, and the ground white with the first decisive snow of
ter. All this Dick knew, as he had been out that day, but
Maje, who was stone-blind and nearly deaf, was ignorant of
situation. Dick at once stopped his fun and went out with
old dog. The poor old beast was on a call of nature; Dick
erstood it all, and by certain pushes and other little canny
ices got the old fellow to a proper place. Returning, he con-
ed the same kind offices, taking care to get so beside the
d dog as to prevent his passing the door. Now just think
ll this. The new snow had put the blind dog at a disad-
tage by rendering the faculty of scent of small avail. All
the young dog comprehended; and then he did not wait
the old dog to make known his wants by a cry or otherwise,
actually and promptly anticipated them. Allowing the dog-
d to have worked as would the man-mind,—and what other
in this case is supposable?—then are there not some fine
ts in this benevolence of the young dog? We may men-

tion, too, that this self-imposed charity of the young dog was regularly repeated under similar conditions. An instance may be stated, as it excited in us who watched from the window both amusement and admiration. Though there was no snow, the day was extremely cold. The old dog wanted to go out, and Dick, of his own accord, took charge of him. I verily believe that the conception of the young dog was that the old dog stood in danger of getting frozen from inability to find his way back to the house. But the old fellow, who does nothing but eat and sleep, is as fat as a bear about hibernation time. He fairly waddles with his environment of adipose tissue. Not so his youthful guide, who is wiry and lean from incessant activity. Now old Maje, feeling no discomfort, was in no haste to return ; but poor Dick stood shivering with the severity of the weather, and actually whined in his impatience to get the old dog home again. Still, notwithstanding the provoking insensibility of the old dog, his young benefactor did not leave him a moment until he had him safely housed once more.

On this twenty-ninth day of February I went to see a seal on exhibition in New Brunswick, New Jersey. It had just been captured in the Raritan River, but a little below the city. The animal had fallen victim to a habit well understood by fishermen in other parts of the world, that of visiting a seine for the purpose of stealing fish. The difference was that this was a young seal, — it weighed but one hundred pounds, — and was not up to the tricks of the old ones, who knew the ins and the outs, and could elude the fishermen. This baby seal was rather pretty. Its sides were mottled with *quasi*-leopard spots on a brown ground. The species was *Phoca vitulina*, the calf-seal, so called because of a calf-like cry which the species can make. There was nothing calvish in the conduct of the captive, however. Its captors were attentive to its wants, and really very kind to it. One of them undertook to pat it on the head, and got an ugly bite for his goodness. And what a head, so like that of a highly intelligent dog ; well might Cuvier call the group *Callocephalus*, the beautiful-headed beasts, so pretty are they, and so knowing, with their large, black, lustrous eyes. Now, among the quadrupedal mammals, the seals almost seem to lead off the *Educabilia*, or intelligent animals, in cranial excellence, owing to their high, thin-boned skulls and their large and finely convoluted brains.

It must then be that the seal is not without a faculty for fun. How great its capacity for instruction is, we know. I was greatly

terested in observing its skill in disposing of an unsizable fish.
nfortunately, the seal to thrive in confinement must be well
d ; hence in its best condition it becomes lethargic, and there is
o great a discount on its natural playfulness. They romp and
mble with one another, and have sham contests. But I once
w a seal that had dined to its satisfaction, and had one fish to
are, which was a menhaden. Feeling well after a good meal,
was in excellent disposition. It actually began to play with
at remaining fish. It would seize the fish in its mouth, and,
y means of that singularly springy neck, would with a jerk send
six or seven feet high in the air, and would utter a bark of
light, not unlike a pup, when the prey would fall splashing
to the water. Then in bubbling glee our sea-dog would toss it
to the air again. Then there were certain divings, and splash-
gs, and bodily contortions, and shakings of the insensate fish as
it were alive, — actions all indicative of high animal enjoy-
ent. I should think that this sport continued not less than ten
inutes, when the animal probably was somewhat tired.

The question arises as to the kind of fun, that is, its mental
aracter. Was it like that of a boy tossing and catching his
ll, a simple exercise of skill? Or was it like the gambol of a
mb or a kid, mere animal gush? I think it was like neither.
had in it a tinge of malicious exultation, the strong making
me of the weak. How a cat will purr while it tosses the poor
ouse, still alive, and perhaps even unhurt. There is in this a
im complacency, what seems to me a sort of vicious enjoyment,
not of devilish delight. The boys had their fun, though it was
ath to the frogs. I think, too, that all this is germane to the
perience of certain natures sodden with chronic irony. There
n be no doubt that carnivorous animals enjoy the excitement
pursuit, and preëminently the success of capture. As a rule,
, it is probably true that while hunger is unallayed no time is
t in sporting with the captive prey; also generally no captures
attempted except when necessity prompts. But some ani-
ls will capture and destroy sometimes for no other reason than
at there is opportunity to do it, and they find fun in so doing.
as, that, in this regard, in most unmanly preëminence stands
n himself!

There is an animal also of thin skull and large brain capacity,
ted for its puffing and blowing as it gambols in the sea. This
the porpoise, *Phocæna communis*. Twenty years ago it was
en seen in Raritan Bay. To us the sight was full of interest.

With what a rhythmical movement these monsters would gambol along in line, one huge fellow taking the lead, and every one behind duplicating his movements, pretty much like the play of boys, "follow your leader." These porcine mammals of the sea follow the migrations of the *Clupidæ*, the family of fishes in which the shad, menhaden or moss-bunker, herring, and others are found. Thus we see it especially in the spring and fall. As food is his object, the porpoise keeps in their wake, and that of the fierce and active blue-fish, *Temnodon saltator*. Not more terrified would a herd of gazelles be before a band of tigers, than is the moss-bunker, *Alosa menhaden*, when pursued by the blue-fish. The poor things crowd like a moving bank, compacted by the devouring pursuer, and the pursuer, so intent upon his victims, is in turn pursued; for the porpoise is pressing behind.

Though I implicitly believe it myself, yet I did not see what I am about to relate. I have heard it more than once from the eye-witness, an intelligent and much-respected man. He had been commander of a coasting vessel. Said he, "It was early fall, and I was running with garden stuff from Keyport to New York. I saw several porpoises. They were going in a line, much as you always see them, but the two head ones had each a blue-fish, with which it played as a cat does with a mouse. They were some distance off, and I might be mistaken about the height; but each porpoise would throw up its fish high into the air, maybe ten or twelve feet, as nigh as I could judge. Just after each toss-up of the blue-fish, each porpoise would duck its nose, by a forward pitch of its body."

"That was indeed surprising. Let me ask, Did each porpoise catch the fish when it fell?"

"That I could n't say, but should think most like not. I think it picked the fish up each time. One of them I know tossed its fish up at least seven times in close succession, before it stopped. I am satisfied, too, that it was one and the same blue-fish all the time."

"Well, well," we thought. "Then this queer, ogreish fun is found among porpoises, seals, and cats! And is not this, the grimmest, whether among animals or men, also the lowest humor?"

In regard to Jack's lassoing the chestnuts on the floor, I do not see, with an able thinker, the necessity of his inheriting the trick, as an achievement by some arboreal ancestor who used a vine or pliant twig to loop in some coveted fruit on the tree.

hat Jack might have had a grandfather smart enough for that,
e may not dispute; but that he ever had an ancestor similarly
ld in limbo, and tried as he had been, is far from probable.
ecessity is the mother of invention; and to me it seems that
ck, with no thanks to any ancestor, had to exercise his own
ts in an original way. We had a coati-mundi, *Nasua fusca*,
ich we often tantalized with an egg, a dainty that it loved too
ll. Having tied the animal by the neck to the table leg, the
g was put at an unreasonable distance on the floor. The ani-
l would tug at the string, and make most earnest efforts to ob-
n the prize, first by the use of the forefeet, and then, failing,
the use of the hinder. This being also of no avail, it would
nge its tactics completely, pulling by its neck at the string, so
to extend its body hindward as much as possible, then stretch-
its tail towards the egg, at the same time bending it to a lit-
curve at the end; then steadying and stiffening the tail by the
of one hand, with which hand a gentle pushing movement
s secured, and the egg was rolled in a curve, which was short-
d by the shortening or increased bending of the tail, and so
prize was brought within reach. To my mind there seems to
e been but one view of the case possible to both animals.
en the exigency first arose, it was to each one a new prob-
, and had to receive from each an original solution. The
key got at it by looping a string, and Nasua by curving the
dal extremity; and, let it be noticed, each one used the im-
vised implement, so to speak, in his hand. In this way the
got the chestnuts, and the other got the egg. The point is
, whatever of intellectual force each might have inherited,
had to meet the exigency for himself, and in his own way.
ti and Cebus had each to rebus the riddle for himself. How-
easy it might be afterwards to each, it was at first an inven-
.

nd now, what of it all? It was not designed to inflict upon
friends a weary homily. We felt like stealing, as through a
k, a glance at the knowingness of the lower animal life. Surely
e is among them, as related to a psychology of their own, a
humor, if one could but get at it; and is it not worth the
ing? This unfeeling humor of the cats and porpoises and
; that dogged gravity, rollicking mirth, and filial bearing of
anine Dick; the chattering sport, the grotesque fun, the utili-
n genius, and the discerning spirit of that "son of Cebidæ;"
flute-like cooing, harmless play, social disposition, and pa-

thetic trustfulness of the poor monkey, Marimonda, — what of it all? "Ah!" said our friend with the orthopterous "doxy," but who is afraid of crickets, and despises bugs generally, "Don't you mind; is it not all simply instinct?" "No," we answer, "but a part of a grand something, more complex and less blind; a fabric which God has been building since before the world." Our friend, who looked astonished, was one who always made full tithes of the anise and the cummin, even if he did overlook the weightier matters of the law. Hence he was so particular about his vowels, too. "Fay-brick, fay-brick," he reiterated; "what do you mean?" "Ay, bricks; ay, bricks, indeed," we said, simulating the sound, "bits of the divine temple, you know. That is all."

OUR WILD GOOSEBERRIES.

BY PROFESSOR ASA GRAY.

THE AMERICAN NATURALIST may be of much use as a medium of communication with every part of the country, and our scattered botanists may turn it to greater account than they have yet done. There are many queries to ask, and bits of information wanted, which the local botanist or zoölogist may answer or supply with little trouble and essential advantage to the science. The only difficulty is to bring the demand into connection with the source of supply. For that I know no better way, in the present instance, than to use the columns of this widely circulated journal, if I may be permitted to do so. Let me say, then, to the botanists, that the wild gooseberries of the United States are not in a satisfactory condition as they stand in the books, and that information and specimens are needed from very various parts of the country. A response to this appeal made by a few persons happily situated, in this and that part of the country, may perhaps clear up the principal difficulties in the course of the current season.

A cursory sketch of our species as I now understand them may show what is most wanting to a better understanding of them.

I. Let us begin with the species which a gardener might say was a cross between a gooseberry and a currant, namely, —

Ribes lacustre Poir., well marked by having racemes of numerous small flowers, in the manner of a common currant, the blossom as small and as open, and the very small reddish berries

set with some scattered bristles. This abounds through the
rth, in cold wet woods from Newfoundland to the Pacific.
here is a dwarf variety of this in the higher Rocky Mountains
d northwestward, smaller in all its parts, and with fewer-
wered racemes. In some publications I have called it *R. se-*
um, a species said to have been raised by the Loddiges from
d sent by Douglas. This very one was received from the
essrs. Loddiges under that name thirty years ago, and cultivated
the Cambridge Botanic Garden. Yet it is not the plant pub-
hed and figured by Lindley, as will be presently seen. I pass

II. The true gooseberries, with peduncles bearing only one or
o or at most four flowers, and calyx-cup bell-shaped or tubu-
. These may be roughly arranged in three sets by the color
the flower.

(1.) Yellow-flowered. The only one of this subdivision is the
R. leptanthum Gray. It belongs to the Rocky Mountains of
lorado and New Mexico, and to the drier parts of the Sierra
vada. It was first collected by Dr. Edwin James in Long's
pedition, but was named and described long afterwards, from
ndler's New Mexican collection. It is an insignificant, small-
ved, and slender-flowered species. The dried flowers do not
m to have been really yellow, but they are said to be so by
collectors in the Sierra Nevada, where, however, the flower is
erally shorter, broader, and more downy. We would ask
se who have met or may meet with it in the Rocky Mountain
ion if the flowers are really yellow or yellowish there.

2.) White or greenish flowered, sometimes with a dull pur-
h tinge. To this division belong all our edible gooseberries,
here lie the main difficulties in the way of distinguishing
species.

wo of these may be known from the rest by having the lobes
he calyx decidedly shorter than the tube, and their berries
apt to be prickly. They are

. setosum Lindl., a white-flowered species with a narrow cy-
rical calyx-tube. It takes its name from the slender scat-
d prickles on the branches; but these are sometimes wanting,
being an inconstant character in all the species. The young
ies are either perfectly smooth and naked, or beset with a
bristly prickles. This is the *R. oxyacanthoides* of Hooker's
a, but certainly not of Linnæus. It belongs to the Saskatcha-
region, extending into Montana and Wyoming. No. 107 of

Dr. Parry's Wyoming collection is a small-leaved form of it, which was mistaken for *R. leptanthum;* but the flower is perfectly smooth, evidently white, and the style deeply cleft and hairy towards the base. I suspect that this species inhabits the northwestern shore of Lake Superior. Botanists visiting that district should look for a species with pure white flowers, a half-inch or less in length, with cylindrical tube, and stamens decidedly shorter than the lobes.

R. cynosbati L. This dogberry, as the name denotes, is well marked by the usually strong prickles on the fruit, weak prickles on the stems (the thorns sometimes wanting altogether, but occasionally well developed), slender peduncles, and especially by the broadly bell-shaped tube of the greenish flower. It is common from Lower Canada to Illinois, and in the Alleghanies to Virginia. It is found occasionally with the berries as well as the stems wholly unarmed.

In the rest of this section the calyx-lobes are decidedly longer than the short, bell-shaped tube; and the berries are smooth and naked, purple, sweet and pleasant-tasted.

R. gracile Michx. is the most distinct of them. It is well named on account of the slender peduncles, long and narrow calyx-lobes, and almost capillary filaments. The latter are half an inch long, generally connivent or closely parallel, and soon conspicuously longer than the oblong-linear calyx-lobes, which, being reflexed in anthesis, as in all these species, then expose the whole length of the stamens to view. The flower is whiter than in the rest of these species, having barely a slight tinge of green. The berry is pretty large, and is prized in cultivation, under the name of Missouri gooseberry. It is the *R. Missouriense* of Nuttall in Torrey and Gray's Flora. It is also, as the figure shows, the *R. niveum* of Lindley in the Botanical Register; and from the character, it is probably the *R. triflorum* of Hooker's Flora. It ranges from Tennessee and Illinois to the northern borders of Texas, and northwestward into the Rocky Mountains. In Michaux's Flora the habitat is the mountains of Tennessee; but I suppose it will not be found in the Alleghanies. A note with the specimens in his herbarium at the Jardin des Plantes records that they were collected "in itinere Nashville."

R. rotundifolium Michx. is a species of the Alleghany Mountains, ranging northward and eastward into New York and the western borders of Massachusetts. Professor Dewey long ago collected it near Williamstown, and Professor Tuckerman's Am-

rst catalogue gives West River Mountain, on the authority
Hitchcock. I wish to obtain flowering specimens of it from
l parts of its range ; for the limits between it and the following
e obscure. Its range is more southern and comparatively re-
ricted ; the flower is narrower, and the stamens longer, becom-
g a quarter of an inch in length and nearly double that of the
lyx-lobes ; the peduncles also are longer ; but this character
es not hold out well. Although it belongs to a district most
all familiar to botanists, I have seen few flowering specimens.
he New York catalogue in the *Bulletin* of the Torrey Club
tes " Fort Lee, W. H. L., and foot of 60th Street, North River,
Roy." A specimen of the latter is preserved in the Torrey
rbarium, and is the European gooseberry. *R. triflorum* Willd
I think, rightly referred to *R. rotundifolium*, an earlier name.

R. oxyacanthoides L. We must bring this name into use in
ace of *R. hirtellum* Michx. (which is generally inappropriate),
no reasonable doubt remains that it is the Hudson's Bay
oseberry, figured by Dillenius, upon which Linnæus founded
species. It is the common smooth-fruited gooseberry of
w England and the whole region northward, and it extends
stward to and beyond the Rocky Mountains, and even into
Sierra Nevada of California. It has shorter peduncles than
preceding, but this distinction is by no means absolute ; the
wer is broader, and the stamens merely equal or only slightly
eed the calyx-lobes. It is the *R. saxosum* of Hooker, whose
oxyacanthoides is *R. setosum*, while that of Michaux is *R.*
ustre.

R. divaricatum Douglas. This takes the place of all the pre-
ing on the Pacific side, and ranges from the lower part of
ifornia (in a downy form, *R. villosum* of Nuttall) to British
umbia, meeting *R. oxyacanthoides* in the interior. There is a
n (var. *irriguum*, the *R. irriguum* of Douglas), of which we
w too little, which comes near to *R. rotundifolium*. The
cies is pretty well marked by its slender peduncle and pedi-
, mostly 3–4-flowered, oblong and livid-purple calyx-lobes,
short and broad tube ; the stamens about a quarter of an
long, and thrice the length of the broadly wedge-shaped
nearly white petals. The flower, ovary included, is from a
d to half an inch long. The berries are said to be excellent.

3.) Red-flowered species. These all belong to the Pacific side
he continent, are large-flowered, and their berries are unfit to

R. Lobbii Gray. I am under the necessity of giving a name to this little known but apparently very distinct species. It is figured by Hooker in the *Botanical Magazine*, tab. 4931, as *R. subvestitum* Hook. and Arn., from a Californian plant sent by the late Mr. Lobb (whether seeds or young plants is not mentioned, probably seeds) to his employers, Messrs. Veitch and Son. But the only specimens I have seen are one, exactly agreeing with the plate, from Kew, ticketed "Vancouver's Island, Wood," and another, from the Willamette, in the same region, collected by Mr. Howell. It should be particularly looked for in California, north of San Francisco Bay, and along the coast to British Columbia. Perhaps the Californian habitat is an error. The species may be distinguished by its dark, purplish-red calyx of half an inch in length, not counting the ovary, nearly white petals half the length of the stamens, very glandular but unarmed ovary, and especially by the short, oval, and very blunt anthers, which are dotted with a few warty glands on the back. These short and blunt anthers are shared with all the preceding species, but not with the following.

R. Menziesii Pursh, well marked by its sagittate anthers, with a mucronate tip. The flowers are as large as in the preceding, or considerably larger, but variable in this respect, and of a similar purplish-red color; and the berry is large and prickly, usually densely, sometimes sparsely so; the prickles sometimes strong and spiny, sometimes shorter, bristle-like, and when young gland-tipped. It extends from the southern part of Oregon through the whole length of California, and varies exceedingly. *R. subvestitum* Hook. and Arn., as to all the specimens of Douglas, on which it was founded, is a form of the species not far removed from the typical. *R. Californicum* and *R. occidentale* Hook. and Arn. seem different enough in the original and in many other specimens, being very small-leaved and mainly glabrous. I had formerly (in the fourth volume of the Pacific Railroad Explorations) united these two with *R. subvestitum*. I am now of opinion that all are forms of *R. Menziesii*. They are, however, commended to the notice of native Californian botanists.

R. speciosum Pursh. The scarlet-flowered gooseberry of California is so distinct that a separate section has been provided for it. Besides the bright color and ample size of the flowers, its calyx-lobes do not turn back, and are often only four; the stamens protrude for an inch or more, and the rather dry berry is few-seeded. Its synonymous names are characteristic: *R. stamineum* Smith, for the remarkably long stamens; *R. fuchsioides* Berlandier, for the resemblance to a fuchsia-blossom. In England, where it is hardy, it is prized in cultivation for its brilliant red flowers garnished by the shining and almost evergreen leaves. Trained to the wall of a house, it may be carried to the height of fifteen or twenty feet.

A synoptical view of the species will be convenient: —

Flowers several in a raceme, small and flattish, greenish	R. LACUSTRE.
Flowers 1 to 4 on the peduncle (calyx-tube at least as high as broad):	
Yellow or yellowish, tubular	R. LEPTANTHUM.
White, tubular, with short lobes	R. SETOSUM.
Greenish, with lobes shorter than the bell-shaped tube	R. CYNOSBATI.
White or whitish, narrow, with lobes longer than the tube and shorter than the half-inch stamens	R. GRACILE.
Greenish or dull purplish lobes; longer than the tube:	
Nearly equaling the stamens	R. OXYACANTHOIDES.
At length shorter than the stamens:	
Calyx-tube and lobes rather narrow	R. ROTUNDIFOLIUM.
Calyx-tube and petals broad	R. DIVARICATUM.
Purplish-red, larger; Pacific species:	
Anthers oval, pointless	R. LOBBII.
Anthers sagittate, mucronate	R. MENZIESII.
Scarlet-red, very long-stamened, Californian	R. SPECIOSUM.

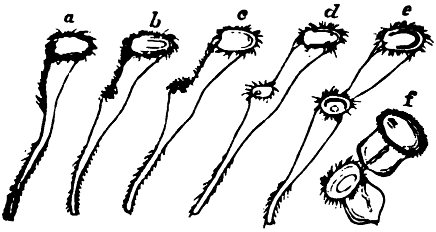
ULTIPLICATION BY FISSION IN STENTOR MÜLLERI

BY HON. J. D. COX.

HAD the good fortune, one evening lately, to observe the whole process of the division of a large *Stentor Mülleri* into o complete individuals, by fission. The circumstances were orable for pretty carefully noting the phenomena exhibited as change went on, and there were some of them which I have seen narrated, and which have a direct bearing upon the stion of the organization of this group of infusoria.

The water was from the Maumee River at Toledo, Ohio, on ke Erie, and contained a good variety of infusoria and of roti-, which had propagated quite rapidly in the glass jar, among e aquatic plants carelessly thrown into it. The specimen of ntor under consideration attracted my attention by its size, it was about four hundredths (.04) of an inch in length, the k being stretched till it appeared about one half longer than proportions shown in the engraving of *Stentor Mülleri* in the rographic Dictionary.

Whilst examining other forms in the compressor, I returned to from time to time to enjoy its beauties, and soon noticed that the ciliary motion was extending from the disk, at the point of depression in its horseshoe shape, down along the body about one quarter of its whole length, and this gradually became more marked until the Stentor presented the appearance shown in outline in Figure 16 *a*. The portion of the body immediately under the disk swelled slightly, and the general form somewhat resembled the flower of the calla lily.



(FIG. 16.) PROCESS OF FISSION IN STENTOR MÜLLERI.

The next change noticed was that at the bottom of the slit in the side the opening took a rounded form, so that the chain-like motion of the cilia looked (as a member of my family expressed it) as if a chain were running over a little pulley, and the cilia made a continuous fringe around the disk, down the body, and around the circular end of the slit, as shown in Figure 16 *b*.

The body now began to show a protuberant swelling immediately under the small circular opening at the lower end of the ciliated slit, and in a few minutes this enlargement equaled in diameter the previous thickness of the body of the Stentor at this point, thus doubling its size at the point of greatest expansion. The protuberance was distinctly on one side of the body, and appeared as an excrescence, the ciliated line running out to its apex, and the Stentor now showing the appearance outlined in Figure 16 *c*.

The swelling continued to increase, involving gradually the whole circumference of the body of the animalcule, the upper side of the protuberance assumed a sharper angle to the longitudinal line of the body, becoming more disk-like, while the line of the cilia enlarged so as to show an approach to the general form of the original head of the Stentor, the new oral opening gradually enlarging and deepening. Figure 16 *d* shows the appearance about a quarter of an hour later than that represented by Figure 16 *c*.

The slit line between the two disks now disappeared, and at the end of another quarter of an hour the upper portion of the body was attached to the lower by a connection no thicker than the tail of the original had been, though in each the disk was about one third smaller than the original disk, and the slope from it to the smaller part of the body below was much less abrupt than in the usual stretched form of the animal when its disk is expanded. Figure 16 *e* represents its appearance at this time. The oral opening of the lower disk was now plainly seen to connect with the general internal canal by a circular orifice which varied in size, sometimes disappearing as if closed by a sphincter.

Up to this period of development the Stentor had kept its place, attached by its tail to the upper glass of the Wenham compressor, its body stretched at great length, its cilia in rapid and vigorous motion, the whole animal waving slowly or parially rotating on its longitudinal axis. Now, however, it quickly etracted with a spring like the recoil of a bit of stretched India-ubber, in the manner common to it and the smaller Vorticellæ which have long pedicels. The two parts of the body, or more roperly the twin bodies, enlarged in diameter while shortening n length, and it was apparent that the mass of each was about qual to the other, although the lower part had been more than wice as long as the upper when the whole had been stretched at ll length. The form of the parts was now almost exactly alike n each, and resembled the common bell-shaped Vorticellæ, such s *Vorticella campanula*, etc. In the retraction the internal canal, hich now became plainly visible, also enlarged in diameter when lieved from the stretch, and appeared slightly convoluted. It assed out from the lower body just below the margin of the sk, and entered the upper body at its caudal extremity, appartly having only an extremely thin membranous wall at the oint of junction of the two bodies. These bodies now began a rt of swaying and gyratory motion, the lower one still fast to e glass by its tail, and the upper one swinging slowly around, e umbilicus between the two becoming smaller and smaller as if risted up. Figure 16 *f* is a sketch of the appearance at this time.

Suddenly the connection parted, and the two Stentors swam parately away, both assuming the common form of the animalle when free-swimming, and differing from the original indilual only in being of smaller size.

The complete transformation through all the stages I have ted occupied about two hours. I did not observe any internal ference of structure at the point where the swelling first began. distinctly marked internal canal or sack could be seen when e body was stretched to its full length, but the manner in ich it became unmistakably visible on the sudden retraction fore the final separation of the parts looked strongly as if it d been there, but was drawn out to such tenuity as to be no ger apparent through the semi-translucent body.

Again, there was no doubt in regard to the fact that the ciliated line or slit extending from the disk down the body of the animalcule became apparent only after it had been some time under observation, and that the length and activity of the cilia along it increased rapidly within a very few minutes, so as to become a striking and marked feature of its appearance. This raises the question whether the fringe of cilia down the body, as described, is a specific characteristic of the *Stentor Mülleri*, or is not rather a mark of the beginning of fission in all Stentors, — a question which an amateur naturalist may state, but will not presume to express an opinion upon.

In the instance above reported it is noteworthy that, except in the first appearance of the ciliated line down the body, there was nothing resembling a division by cutting or splitting. The body was of larger diameter than before, both above and below the new disk, when it first assumed the form of a protuberance with a ciliated circle on its anterior side ; and the subsequent diminution of the diameter of the body and tail of the upper individual was gradual throughout its length, through the stages shown by the drawings.

The observations were made with a quarter-inch objective of low angle, but excellent definition and penetration, with the B eyepiece, and the situation of the Stentor in the compressor was very favorable for an unobstructed view of the phenomena at all stages.

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PRIMITIVE MAN.[1]

THE steady progress of discovery justifies the inference that man, in the earliest periods of his existence of which we have any knowledge, was at the best a savage, enjoying the advantage of a few rude inventions. According to the theory of evolution, which has the merit of being based on and not being inconsistent with observed analogies and processes of nature, he must have gone through a period when he was passing out of the animal into the human state, when he was not yet provided with tools of any sort, and when he lived simply the life of a brute.

No proofs, however, of man in this earliest stage have as yet been found, and the term "primitive man," if intended to be strictly applied, is at present a misnomer. The earliest traces thus far discovered do not reveal to us his beginning. This is still hidden in that mysterious past out of which he has emerged and into which neither science nor exploration has as yet pene-

[1] From the late Professor Wyman's Shell-Mounds of Florida.

rated. The ancient remains found in California, brought to the
otice of the scientific world by Professor J. D. Whitney, and
eferred by him to the tertiary period, exhibit man as a maker of
struments for grinding grain, and other implements of stone,
nd, as far as an imperfect skull goes, essentially the same in his
natomical features as now. Or should those instances be set
side, as some geologists, waiting for further discoveries, are in-
ined to do, we still have remains from the gravels of the
omme in France, as well as the Ouse and other localities in
ngland. Some of these last, Mr. Evans believes, date back to
e time when the Needles of the Isle of Wight were connected
ith the mainland, the sea of Solent was the mouth of a river,
d Britain was probably still a peninsula. The time since these
nditions existed may not, he says, be estimated by years, but
questionably extends back an immense period beyond that
vered by history. The abundance of flint implements belong-
g to the gravels above referred to shows that man was then and
ere far from being primitive.

If the theory of evolution be true, and man was ever in a tran-
ional or strictly primitive state, without tools or implements, it
ll be obvious that all the knowledge we can expect ever to
ve of him in this condition must come through the remains of
own body, older than his inventions, which will carry us back
l further towards, if not to, his starting-point, as the geologist
carried back in time to the early period of the existence of
mals. Even with regard to these, geology fails to reveal to
their actual beginning. Possibly the early remains of man
y never be known, for during the revolutions which have
en place on the surface of the earth and the inroads which
sea has made upon the land, if a suggestion of Cuvier may
accepted, "the places where he [man] dwelt may have been
rly destroyed and his bones buried at the bottom of the ex-
ng seas."

t is almost certain that his bones, if simply left on the sur-
, would, like those of land animals generally, be soon entirely
royed, either by the effects of the weather or by their consump-
for food by wild animals. Nothing can be more striking
the complete destruction of the bones of the birds and rep-
, some of gigantic size, which once thronged the shores in
valley of the Connecticut River. Were it not for the pres-
tion of their seemingly more perishable footprints, the mere
wledge that they once lived would not now exist. The same

is doubtless true of other kinds whose habitat was inland, and whole races of mammals and birds may have once existed of which no traces whatever remain, and this too within comparatively recent times. Keeping these considerations in view, it seems not at all improbable that the same fate may have befallen the remains of the earliest man.

As the ease with which food can be procured determines the habitat of animals, so also it determines that of man, and this naturally brings him to the shores of seas, lakes, and rivers, where it can be had with the greatest ease. It is hardly conceivable that he could, under any circumstances, at once have entered upon an agricultural or hunter life, since these both require expedients and inventions which long experience and education alone can give. Without tools or inventions of any sort, life in the forest, it would seem, would be for him almost impossible. Be this as it may, the wide geographical distribution of shell-heaps shows how generally man has been attracted by the kinds of food the shores yield, including not only shell-fish but fish and game, and the extent to which they have supplied his wants in his early periods. They are found at intervals along the whole Atlantic coast of the United States from the Bay of Fundy to the Gulf of Mexico, on the shores of California and northward to Behring's Sea, in Central America, the Gulf of Guayaquil, on the coast of Brazil, Patagonia, and Terra del Fuego, on the shores of England, Scotland, Ireland, France, and Denmark, in the Malay Peninsula, in Australia and Tasmania, and will doubtless be discovered in still other parts of the world.

Besides those just mentioned, other shell-heaps have been found on the interior rivers of the continent, especially the Mississippi and its tributaries. Atwater, who was the pioneer in inquiries relating to them, described the mounds of mussel shells on the banks of the Muskingum, containing various articles of human make, and LeSueur and Say explored a mound at New Harmony, Indiana, as early as 1826. Since then Dr. D. G. Brinton, Dr. Cox, Generals Humphreys and Abbott, and Professor C. A. White have described many other localities in the great Mississippi Valley where they exist in large numbers, and show how generally the habit of eating shell-fish prevailed in that region. In addition to the fresh-water shell-heaps of the St. John's, Florida, we have examined a well-defined shell-heap on the shores of the Concord, in Massachusetts, consisting of *Unio complanatus*, living specimens of which can be had from the river ear by. This shell-heap contains charcoal and pieces of worked one and stone. It had been previously visited by the late H. . Thoreau, who regarded it as an ancient Indian dwelling-place, hough he published no account of it. Quite recently Professor artt, of Cornell University, has explored some of the interior esh-water shell-mounds of Brazil, which are very extensive, lections from which are preserved in the Peabody Museum at ambridge.

The study of the works of man from the oldest shell-heaps, e only records left of the progress their builders had made, nds to show that he was as far advanced at least as are the iserable creatures the traveler meets with now in the Straits Magellan, or as are the Dyacks of Borneo, the Australians, or e Andaman Islanders. In other words, we have the life of an manifested now in a condition as primitive and no more adnced towards civilization than in the earliest prehistoric periods hich have thus far been studied.

The only records we have of the earliest inhabitants of the St. hn's River are the shell-mounds and the comparatively few imments they contain. Judging from these of the progress the tives had made, it is clear that they too had passed out of the mitive stage, had become hunters, had made some progress in useful arts; and, however rude their implements, they were h as could only have been the result of long-continued efforts. ey have left no signs of having learned the art of agriculture, their tools, if they had any, may have been of a perishable ure. In the oldest mounds no pottery has been discovered, the lders of them no doubt having been ignorant of it. Though lements of wrought shell, bone, and stone are met with, they not numerous, and those of stone from the interior of the unds are quite rare.

he bones of animals obtained by hunting on land are in comatively small numbers, so that, far as indications go, the older ives subsisted chiefly on fish and shell-fish. This is strikingly case at the mound on Huntoon Creek, Osceola Mound, the und next above Blue Spring, and at Horse Landing. Whether inhabitants who built and dwelt upon the older shell-heaps, ven upon the later ones, were the same people the first exers found occupying the shores of the St. John's is uncertain. Indians who lived in Florida later had no traditions with rd to those who preceded them in remote times, nor is it to xpected that they should have, for they were not the descendants of the original inhabitants, but were comparatively recent immigrants themselves. The early explorers make no reference whatsoever to the shell-mounds on the river, though they could hardly have failed to do so if these had continued to be occupied as dwelling-places, and the fresh-water shells were still to be used to any considerable extent as articles of food. They distinctly state that the natives lived by hunting and agriculture, describe the details of carrying on these operations, the preparation of dried meat, and mention the different articles, animal and vegetable, used, their mode of collecting food in granaries, and of preparing them ; but nothing is said of the shell-fish. The inference is that the shell-mounds had already ceased to be occupied as dwelling-places, and that the natives had outlived the mode of life which gave rise to them, or had been replaced by others of different habits.

This conclusion is consistent with the fact that trees are now growing on some of the mounds, which are older than the discovery of America.

Unfortunately, we have no satisfactory means of making a comparison between the older and the later inhabitants, derived from parts of the human skeleton. There is an abundance of crania and bones taken from the burial-mounds, but it is hardly safe to assume that these represent the earliest dwellers on the St. John's. The bones from Osceola Mound and those from Rock Island, in Lake Munroe, are the only ones we have met with which can be claimed to be unequivocally contemporaneous with the earliest shell-heaps. The skull from the first of these places has anatomical peculiarities which differ from those of the skulls of the burial-mounds, but as there is but one, it may be exceptional.

The relation of the older to the later inhabitants, that is, of those dwelling on the St. John's centuries before and at the time of the first explorations, must remain for the present a matter of doubt. We need more complete explorations of the burial mounds than have as yet been made, and more complete anatomical comparisons of the crania and bones.

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THE CAVE BEETLES OF KENTUCKY.

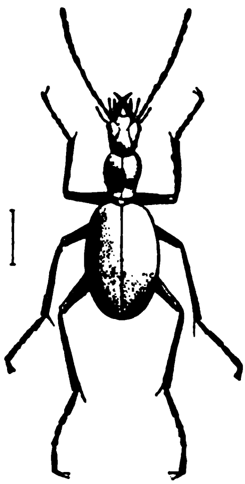
BY A. S. PACKARD, JR.

THOSE who have gone the rounds of Mammoth Cave, crossed the river Styx, with its muddy banks, passed through Fat Man's Misery, through the damp passages of the Labyrinth, d lunched by Richardson's Spring, know that not a little dismfort is experienced in the course of the journey. But for e insect-hunter, who must spend hours on his knees in search; for the less common forms, or lie prone on his face on damp ıd-banks, — the bed of the ancient stream which tunneled these underground passages, — wearied vertebræ and kneents, the smoke and drippings of the oil lamps or candles, are drawbacks which must be endured if he would be successful his search for cave life. By two or three weeks' research in a of the caves of Kentucky, in company with Professor Shaler, harge of the Geological Survey of Kentucky, and with the aid Mr. F. G. Sanborn, we were enabled to more than double the aber of species of insects known to inhabit Mammoth and ading caves, and to discover a new and rich cave-fauna in the ter caves in the eastern part of the State; while in examining yer's Cave, in Virginia, not known before to be tenanted by cts, some twenty species were discovered by the writer. The lts of our researches on the spiders of these caves have already given in the NATURALIST (ix. 274, 278), by Mr. J. H. rton and myself. In the present brief essay I propose to draw ation to the amount of variation in the cave beetles, and to early stages of a few species, referring the reader for more ils to papers hereafter to appear in the memoirs of the Geoal Survey of Kentucky. It may here be said that the flies been examined by Baron Osten Sacken, the beetles have identified by Dr. J. L. LeConte, while the Amphipod acea have been identified by Prof. S. I. Smith, and papers e Phalangids and other low arachnids and the mites are in e of preparation by the writer.

the two genera of blind beetles (*Anophthalmus* and *Ade-* which occur in caves in Kentucky and Southern Europe, maller form is *Adelops*. Its appearance and habits are very ent from those of *Anophthalmus*. It belongs to the family rying beetles, or *Silphidæ*, the larger species of which are n to deposit their eggs in dead birds, mice, etc., previously ng them beneath the surface of the soil. The *Adelops*, ver, is allied to a diminutive member of the family, *Catops*, ecies of which live in fungi, carrion, or in ants' nests. The *ps* (Plate II., Figure 4, enlarged), named *Adelops hirtus* by 'ellkampf, its original discoverer, is most abundant under stones at Richardson's Spring, where parties have for many taken their lunch, the remains of which form a perennial pasturage for these beetles. It is probable also that the dead bodies of bats, crickets, and smaller insects sustain them in other caverns and in different portions of Mammoth Cave.

The other blind beetles, various species of *Anophthalmus*, prey without doubt chiefly on living objects, perhaps the young of their own kind or of the *Adelops*, as they belong to the family of carnivorous beetles, the *Carabidæ*. They are found running over damp sand-banks, sometimes hiding in little pits under stones.

Six species of *Anophthalmus* are known, of which *A. Tellkampfii* is the largest and most abundant, occurring in Mammoth and the neighboring caves. Next to this, *Anophthalmus Menetriesi* of Motschultzy is most common. In the grottoes near Mammoth Cave, Cave City Cave, and Walnut Hill Spring Cave, near Glasgow Junction, Mr. Sanborn found *Anophthalmus pubescens* Horn. In Wyandotte Cave *A. tenuis* Horn and *A. eremita* Horn are the only blind beetles found, and the former has been found in Bradford Cave, Indiana, by Dr. John Sloan and myself. The larger number of species occur in the Mammoth Cave region, while in the Carter caves of Eastern Kentucky only one species (*A. pusio* Horn) occurred, which was originally discovered by Professor Cope in Erharts Cave, Montgomery Co., Virginia. No *Adelops* has occurred away from the Mammoth Cave region.



(Fig 17.) ANOPHTHALMUS.

The subject of the degree of variation in these cave beetles is an interesting one. So uniform are their physical surroundings: the perpetual darkness, even annual temperature, varying but very slightly winter or summer, unless in the smaller caverns; the dryness of the air, though after the spring freshets the caves are doubtless damper than at other seasons of the year (this may not be the case with Wyandotte Cave, which is remarkably dry compared with Mammoth Cave); all these conditions must certainly tend to produce much persistence of form and size in these beetles.

I will give a few notes regarding differences in size, to show how much variation does occur. In twenty-two specimens of *Anophthalmus Tellkampfii* (0.30 inch in length) from Salt Cave,

ere was absolutely no difference from a number of examples of
same species from Mammoth Cave. Eleven *A. Tellkampfii*
m White's Cave, a small cavern near the surface, did not
fer in any respect from a number of Mammoth Cave specimens,
th sets measuring 0.30 inch. Fourteen *A. Tellkampfii* col-
ted by Mr. Sanborn in Sugar Bowl Cave, three miles north-
st of Glasgow Junction, were the same as those from Mammoth
ve, but among them was some variation in size; the longest
ividual was 0.30 inch, the shortest 0.25 inch. Out of sixty-
A. Tellkampfii collected by Mr. Sanborn in Long Cave,
rly one mile from daylight, the longest was 0.30 and the
rtest was 0.25 inch. Out of twenty-seven specimens of *A.*
lkampfii from one locality in Mammoth Cave, the Labyrinth,
amount of variation was exceedingly slight, none being over
inch and the smallest 0.27 inch in length.

he smaller species of *Anophthalmus* seem to vary more than
lkampfii, probably owing to the fact that the caves they occur
re in most cases smaller, nearer the surface, and therefore with
ss equitable temperature and more sudden alternations of
pness and dryness. For example, of eighteen specimens of
enuis, the largest measured 0.20 and the smallest 0.16 inch,
there was less uniformity in size among these than in *A.*
kampfii from Mammoth Cave, for nearly a third were smaller
the others, while out of about eighteen *A. Tellkampfii* only
or two were dwarfed. Individuals of *Anophthalmus Mene-*
i (also a smaller species than *Tellkampfii*) from different
s, varied somewhat in size. The *Adelops hirtus* varies more in
ortion than the species of *Anophthalmus;* thus of twenty-
examples all taken from the Labyrinth, the largest were 0.12
long, and the smallest 0.09 inch. Of this species two thirds
males. It appears, then, that there is a slight variation in
and the main factor in bringing it about seems rather to be
want of sufficient food than any other cause. The tendency
riation is to a diminution of size, and this is generally among
ts, where the climate is not extreme, owing to lack of suffi-
food. And to the wanderer in these great grottoes the
ght constantly presents itself to the mind, How do these in-
, few and scattered as they are, get enough to live on? The
etual hunger they must undergo was well illustrated in
ndotte Cave, where, on kneeling in the path, one could see
bers of the common myriopod of that cave (*Scoterpes cav-*
rum Cope) gathered around the hardened drops of tallow

which strew the pathways of that wonderful cave. One could almost hear them, in the stillness of the Titanic corridors and domes of that magnificent cavern, exclaim over a newly fallen drop of tallow from our candles, "Here 's richness!"

A few beetles were found in these caves which had evidently found their way in from out-of-doors, as they had eyes and did not differ from normal specimens. They are figured on the accompanying plate.[1] Figure 1 represents *Batrisus spretus* LeC. (much enlarged), one of the family *Pselaphidæ;* two females were found at the end of Dixon's Cave. It is a common beetle, and ranges from Vermont to Georgia, according to Dr. LeConte. Figure 12 represents *Quedius fulgidus* (much enlarged). It occurred in Dixon's Cave and also in Weyer's; it is a common species in the Middle and Western States. This and two other *Staphylinidæ* or rove beetles, represented by Figures 6 and 7, and a larva of this family (Figure 9) occurred in different caves and all had eyes, being evidently fresh arrivals in these subterranean retreats.

It was a matter of much importance to discover the larvæ, or young, of the blind beetles, the true autochthones of these caverns, in order to ascertain whether the young are born blind, particularly as the larvæ of these genera, so far as we know, had not yet been discovered in Europe. Systematic research in different caves soon revealed several larvæ, both of *Anophthalmus* and of *Adelops*. The young *Anophthalmus* occurred in several caves; particularly in Salt Cave, on damp sand-banks, under stones. Figure 3 represents what is without much doubt the larva of *A. Tellkampfii*. This larva is more closely allied to that of the European *Pterostichus nigrita*, figured by Schiödte, than any other form with which I have been able to compare it, but the body is rather slenderer, the head much longer and narrower, and the mouth-parts longer, while the caudal appendages are shorter. The end of the body is like those of *Harpalus* and *Stenolophus*, as figured by Schiödte, but the mandibles resemble those of *Harpalus*. There are no traces of eyes, and the body is white and

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[1] Explanation of Plate II. Figure 1, *Batrisus spretus*. Figure 2, pupa of *Anophthalmus Tellkampfii*. Figure 3, larva of *Anophthalmus Tellkampfii;* 3 *a*, antenna; 3 *b*, labium and palpi; 3 *c*, maxilla and palpi; 3 *d*, labium. Figure 4, *Adelops hirtus;* 4 *a*, antenna of larva. Figure 5, larva of *Adelops hirtus*. Figure 6, a Staphylinid beetle. Figure 7, a Staphylinid beetle. Figure 8, an unknown blind Coleopterous larva from Bat Cave, one of the Carter caves. Figure 9, larva of a Staphylinid beetle. Figure 11, blastodermic cells of the cave spider, *Anthrobia mammouthia* (see NATURALIST, ix. 276). Figure 12, *Quedius fulgidus*. All the figures are magnified drawings.

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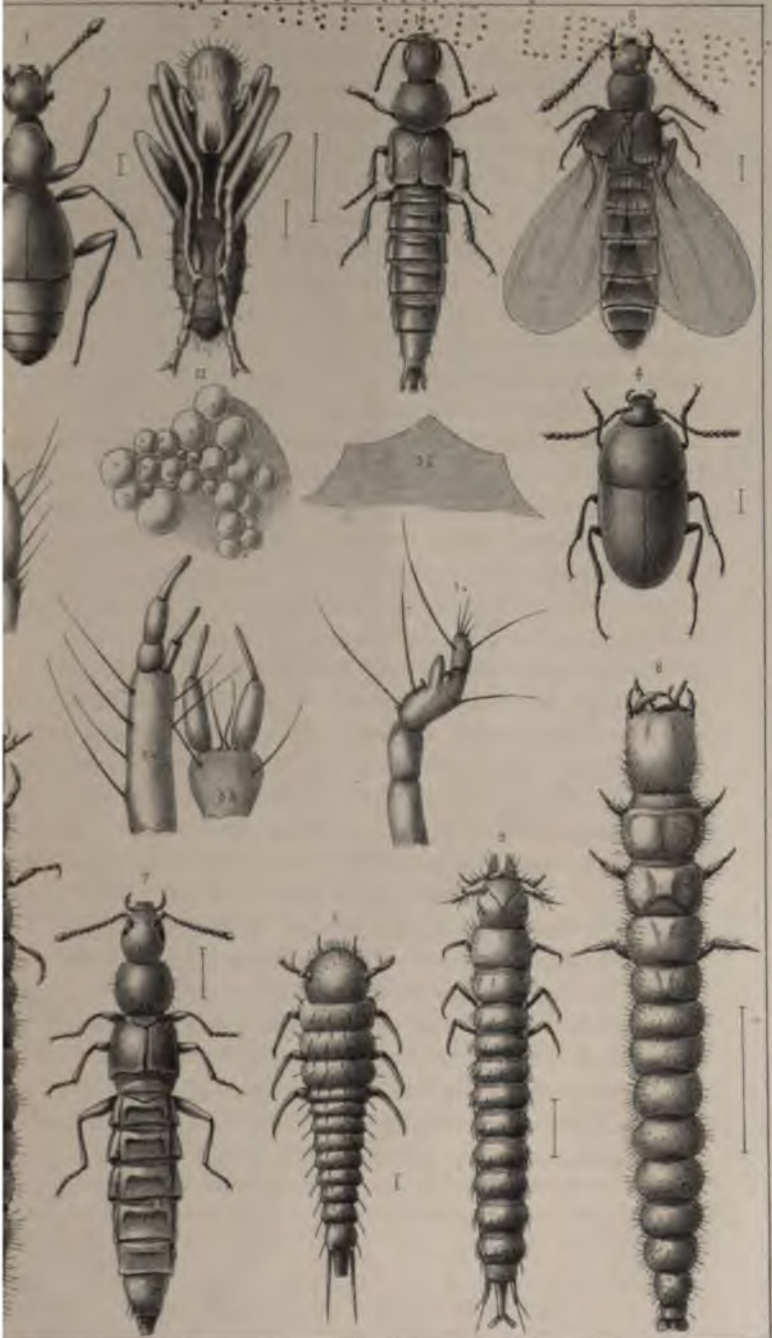

J. Mayer & Co. lith.

CAVE COLEOPTERA OF KENTUCKY.

her soft, not chitinous as in most Carabid larvæ. There is no lpturing on the head, and but a single claw on the legs.

At the same time and in the same sand-banks occurred the pa (Figure 2, enlarged) of the same species. It rested in le pits or cells three quarters of an inch long under flat stones, l was eyeless and white, with the harder parts of the mouth ey-yellow in color.

Though the pupa of the *Adelops* was not found, two larvæ urred, one in the Labyrinth of Mammoth Cave. Figure 5 resents this interesting form, and 4 *a* one of the antennæ mag-ed. It bears some resemblance to the larva of *Agathidium* (I w of no figure of a young Catops with which to compare it), the head is very much larger and nearly as wide as the pro-racic segments. The body tapers rapidly from the prothorax the end, and is provided with long hairs; it is dull white. re are no traces of eyes.

UNIVERSITY INSTRUCTION IN BOTANY.

BY PROFESSOR W. G. FARLOW.

ITHIN the last few years the interest of the public in botanical questions has very much increased, and not only is e a greater demand for popular lectures, but the introduc-of the study of botany into the common schools is beginning e seriously agitated. But who is to teach the subject? If public desire to have botany taught in the schools, it is not, me botanists seem to suppose, because they regard botanical as more important than other facts, — historical, philological, — but because, of all the natural sciences, botany is the most y and cheaply adapted to the school-room, and it is to natu-istory in some form or other that the public look for a rem-for the evil of book-cramming and memorizing which prevails ur schools. But although botany may serve to counteract vil, it will not accomplish that object unless in the hands of teachers, and the very first requisite of a good teacher is a liarity with the subject he is to teach. If the introduction otany into the schools is precipitated, the instructors will sarily be those who are already overburdened with other ches which they are obliged to teach, and which furthermore teach in exactly the way in which botany or any other ral science should never be taught. The school-teachers selves must be taught, and that will not be an easy task, considering how little time they have for study, and how many of them have reached an age when entering upon new habits of thought is not easy. Evidently, if there is to be any instruction in botany in the schools which shall amount to anything, it must come from those who have studied the subject at college, for it is in the universities that botanical experts are found as instructors, and it is only there that any systematic and continued study of the subject can be attempted. Let us see what sort of botany is taught in the universities, and whether any improvement is needed or to be desired.

In many of our universities, and we are not now speaking of agricultural colleges, which must be classed with technical schools rather than with universities, the study of botany is elective, and it would not be far from correct to say that it is chosen by a moderately large per cent. of students for a single year, and continued by a much smaller number, perhaps a third or a quarter, during a second year. In all our colleges, whether botany is compulsory or elective, the students are not required or supposed to have any previous acquaintance with the subject, and in all, the first step is to recognize the organs of flowering plants and to learn their names. As soon as possible, the student is requested to provide himself with a manual; a number of flowers, from the field or the hot house, as the season serves, is then placed in his hands, and he is required, if we may be allowed the expression, to "go through" them. This last process varies somewhat with the fancy of the instructor and the laboratory facilities of the college. Where the botanical chair is combined with those of zoölogy, chemistry, and the modern languages, the "going through" consists in tracking a flower, just as though it were a thief or a woodchuck, to its hiding-place in the manual by means of a key. A neat pencil mark against the specific name serves to indicate one step onward in the mental development of the student. In those colleges where there is a greater division of labor, and one man is obliged to teach only botany and zoölogy, there is generally provided a printed schedule in which the student as he proceeds records the number of stamens and pistils, the interesting fact whether the ovary is superior or inferior, and other similar details, until, having filled his schedule, he is at liberty to turn to the key and follow the course we have previously described.

In a few colleges, during the first year, students of botany, in addition to the analysis of flowering plants, hear a few lectures n cryptogams or vegetable physiology, but the great fact is ever lost sight of that the aim and end of all botanical instruction , at the end of a year's study, to be able to take one's manual, id, with a certain degree of facility, find the names of common owering plants. That is the first task to be accomplished, and ot until it is accomplished is any student to be allowed to take anything else. As a matter of fact, comparatively few students irsue the subject for a second year, if by the university regula- ons they are allowed to give it up; and the question suggests elf, What is the result of a botanical course of one year? The od students who have, under the circumstances, made the best ssible use of their time, are able to analyze simple flowering ants with tolerable ease, and know the characters of some of e orders of phænogams; and those who have not studied so thfully are perhaps able to explain to a cruelly skeptical father at a rose-bush is very much like an apple-tree, or to compare tes with Emily, who has just returned from Miss Smith's Insti- ion for Young Ladies, and, after some months' study, is not ite sure whether the calyx is inside or outside the petals.

We must confess that it seems to us a mistaken notion to teach any as though the naming of phænogams, or even the general rphology of phænogams, was any more important than other ics. We know from experience that but a very small per t. of the students who study botany in college ever do learn ugh to enable them to analyze flowers with any ease, and that n the few who can, rarely continue the study after leaving ege, from want of either time or opportunity for herboriz- . The botanical students in any university may be divided three classes: those who have a passion, a natural aptitude, the subject, whose number is always very small, and includes se who are to become the experts and higher teachers of any; those of good ability and industry, who elect botany ause they hope to find it an aid afterwards when they shall ly a profession or become school-teachers; and those who ct the study as part of a plan of general culture and im- vement. There is a fourth class, but we never mention that, posed of young gentlemen whose principal aim in coming to ege seems to be to get as little good out of it as possible. We ıld like to know which of these three classes is benefited by almost exclusive study of phænogams for the first and, in the of many of them, the only year of their botanical studies. se who wish for general culture get a smattering of the technicalities of one branch of the vegetable kingdom, and are in absolute ignorance of all the rest. Those who think a one year's course, as at present arranged, will help them as teachers, will find themselves without a general notion of the vegetable kingdom, without which it will not be easy to instruct others. The medical man will find that he would be able to recognize several useful plants were it not for the fact that they do not grow within several hundred miles of his home, and, on the other hand, that he has no knowledge either of vegetable histology, which would be a great assistance in his pathological studies, or of fungi, which are interesting in connection with the origin of several diseases.

If we look at the effect of the usual training on the first class we have mentioned, those who really wish to become botanists, the conclusion we must draw is not flattering. Why is it that so few botanical workers are found in this country? Where are the young men of ability and enthusiasm who ought to be working up some of the interesting botanical questions? They are all — studying zoölogy. As botanists, we cannot of course admit that botany is in itself any less interesting than zoölogy, and if we turn to Germany, for example, we find that the proportion of young men who enter on a botanical career there is as large as that of those devoting themselves to zoölogy. If at the present day we are feeling the want of young botanists to investigate or instruct, we must not forget that at the door of every botanical lecture-room the would-be enthusiast has encountered a manual of flowering plants, through which he must make his way if he would see any light beyond. What wonder that many were attracted to the other house, where manuals were not so much in vogue, and the study of development encouraged. It must be said with shame that not a single work on the development or minute histology of any plant or group of plants has ever been written by an American, if we except some of Sullivant's bryological works. It has finally become the prevailing belief that if one would do anything for botany he must find or make new species. It is certainly of the greatest importance that eventually all species of plants should be described, but it is very injurious to have one who has not a large library and herbarium attempt to decide what is new and what is not.

We would by no means disparage the systematic study of phænogams, but by conveying the idea that such a study underlies and is the key to the whole science of botany, numbers

young men whose talents and services could ill be spared
ive been driven to other branches of natural history. The
reat mistake seems to us to have been that it has been at-
mpted to educate all who study botany as though they intended
become botanical specialists in the department of descriptive
hænogamy, whereas not one in a thousand has such an inten-
on or desire.

We would see the instruction in botany for the first year
ther directed to give a good general view of the whole vege-
ble kingdom, than to enable the student to follow out specific
alysis in any one department. We would not forget that
tany is one of the divisions of biology; we would, as far as pos-
ble, examine plants in action, and would let the student devote
time for the first year to the examination of a few illustrations
the different types of vegetable life, from the highest to the
west, without any attempt at teaching particular genera and
ecies. We would teach the student how to investigate for
nself, and avoid imparting any encyclopædic knowledge. At
close of one year's study the student would be in a condi-
n to know in which direction he prefers to work, and in his
ond and later years of study he could pursue more and more in
ail the department which his own taste may dictate, not, how-
r, entirely neglecting others. We think it absolutely neces-
y that in the first year of study a general course should be
sued, in which the student should be obliged to think for him-
, and should not be allowed to depend on books.

o enter into particulars, we should prefer something of this
l: We suppose the college term to begin about the first of
ober and end the first of the following July, and that the
ent spends three hours a day for three days in the week in
laboratory, or, in case a lecture is given on any day, only two
s of laboratory work. The material is selected to suit the
ate of the Northern States.

CTOBER AND NOVEMBER. — One lecture a week. (A.) Il-
ations of *Palmella*, *Nostoc*, *Oscillaria*, *Desmids*, *Spirogyra*,
to show the structure of the cell, and acquire facility in the
f the compound microscope and in making preparations.

.) *Myxomycetes*, to examine the plasmodium. *Nitella*, to
the movements of protoplasm.

.) *Mucor Syzygites*, to illustrate conjugation.

.) *Peronospora viticola*, to show oöspores and zoöspores.

CEMBER, JANUARY, AND FEBRUARY. — (A.) *Basidiomy-*

cetes, illustrated by *Agaricus*, *Lactarius*, *Corticium*, etc., alcoholic material, to show structure of mycelium and hymenium.

(B.) *Ascomycetes*, showing ascospores, conidia, pycnidia, etc., illustrated by *Eurotium*, *Phyllactinia*, *Microsphæria*, *Peziza*, *Morchella*, *Sphæria morbosa*, *Sphæria herbarum*, *Hypomyces*, etc.

(C.) Lichens of different kinds.

(D.) *Fucus*, *Laminaria*, *Ectocarpus*, *Polysiphonia*, *Callithamnion*. (These last can be obtained alive in winter by those living near the sea-coast, and all except Fucus can be kept perfectly well in alcohol.)

The subjects just mentioned for December, January, and February should occupy two days out of the three, part of the time being spent in attending lectures and part in laboratory work. The third day, the organography of flowering plants should be studied.

MARCH. — (A.) Ferns and mosses, structure of prothallus and fruit, one day in the week.

(B.) Vegetable physiology, one day.

(C.) Organography of flowering plants, one day.

APRIL, MAY, AND JUNE. — One day a week to histology of higher plants. Two days to analysis of flowering plants. With a certain number of lectures on vegetable physiology, and in early summer a glance at the *Uredinei*, illustrated by æcidial and uredo forms and dried material of teleutospores.

Such would be the course which we should advise for a person old enough, and with sufficient previous training to be admitted to college. For persons in their first and second childhood, kindergarten methods will do very well, but for young men we prefer work. The course we have laid down requires work with the compound microscope from the very beginning. There is no denying that the microscope has caused a revolution in botany, and no botanist of the present day, no matter what department he may take up, can afford to be ignorant of the practical working of that instrument. Vegetable histology is the very A B C of botany, and no botanical work can be solid unless it rests on that foundation. To be sure, the microscopical societies have done their best to bring the microscope into disrepute, by encouraging the notion that there is a department of microscopy apart from botany, zoölogy, and pathology, and by striving to recommend to the public large and expensive instruments, which, however perfect they may be optically, are ill adapted for steady work and or the slender means of most young people. The microscope as n optical instrument comes under the province of physics, and nicroscopy is no more a science apart from biology and patholgy than is cutlery. We might just as well have a department f cutlery in which we could include those animals and plants hich are usually studied by sections made with razors and nives. Every college where botany is taught should be proided with a number of compound microscopes. Microscopes ufficiently good for ordinary purposes can be purchased in Euope for thirty dollars gold, or even somewhat less, and can be nported free of duty for college use. Even with duty paid, fty dollars ought to secure a very fair French or German mioscope.

Our proposed course implies a tolerably large proportion of boratory work, and we may be allowed here to say a few ords on what seems to be a growing evil in this country, the use of laboratories. A few years ago, when it was seen that struction in natural history could not be imparted successfully om books alone, laboratories were introduced to remedy the il. It was said, In the laboratory the student will see the obct itself; he will learn to compare, to reason, and, instead of erely committing a number of pages to memory, he will have practical knowledge of the subject. But the laboratory system s worked in a curious way, although in a way which might ve been anticipated, and it has not proved such a complete nacea as had been expected. If, on the one hand, to those o are anxious to learn and are fond of investigation, laboratory ercises are of incalculable value, it must be said, on the other nd, that the average American student is thoroughly impressed th the idea that, if he does not understand a thing at once, it the business of the instructor to explain it to him. It never urs to him that it may be for his advantage to work the thing himself. From childhood up, having been taught that eduion consists in the acquisition of facts, he cannot see that the re process of acquiring a fact may be of more importance than fact itself. But the case is even worse. The fourth class of dents which we described, those who wish to have as easy a e as possible, regard the laboratories as especially created for purpose of escaping study, and to the laboratories they flock crowds. They seriously interfere with the work of the good dents, by compelling the instructor to spend a great part of time in explaining things which they ought to work out for themselves. If a shirk is a nuisance in the lecture-room, he is tenfold a nuisance in the laboratory, where he wastes not only time, but room and working materials.

Were the courses in our colleges elective, in the true sense of the word, this difficulty of the crowding of laboratories by students who are not in earnest would not arise. But even where the botanical course is nominally elective, there is a certain compulsion employed in the form of check-lists or compulsory recitations. As it is, we see no other way out of the difficulty than to divide a botanical class of any size into two sections; one including those who are willing to work, who should have laboratory privileges; the other including the shirks, who should be required only to attend lectures and recitations, and who should, of course, be marked on a lower scale. There is no good reason why a college should provide laboratory room and equipments for those whose principal object in going to the laboratory is to try to worm out of the instructor the questions of the next examination paper. There is another class of well-meaning but exasperating students, birds of passage we must call them, who have usually not more than fifteen or twenty minutes to spend at any one time in the laboratory. We see no reason why, if a student actually has no time at his disposal, he should be allowed to throw a laboratory into confusion by a series of abrupt entrances and as abrupt departures.

We have purposely omitted any lectures on economic botany from our proposed course. However useful a study it may be for apothecaries, it is entirely unadapted to college students. They might just as well try to learn so many pages out of the dictionary. It would be very desirable to remember the names and orders of a large number of useful and injurious plants. But no one ever does who is not obliged to lecture twice a year on the subject, and even then he is compelled to refresh his memory by frequent perusal of certain books whose titles we will not mention, for fear that it may be said that we are betraying professional secrets.

In Germany the botanical professors generally give a principal course of lectures, which is attended by those who are paying particular attention to the science, and a shorter accessory course, on some limited subject, which is attended by those who simply wish to know what is going on in the botanical world, without making any detailed study. It seems to us that something similar would be advisable in this country. There is ways a number of students who would like to hear a few lect- es on some of the most interesting topics relating to botany, idents intending to become clergymen, lawyers, business men, hose time is so occupied with historical or philosophical courses at they could not take a regular botanical course. The few nutes which they could spend in a laboratory would be time rown away. They want a few plain lectures on some limited ic, and the topic should be changed from year to year. On year there might be, for instance, six lectures on fertilization higher plants. The next year a course on the lower limit of vegetable kingdom. Or there might be two or three courses six lectures during the same year.

RECENT LITERATURE.

Few Suggestions on Tree-Planting.[1] — The increased inter- awakened of late in arboriculture may be attributed in part to a izing sense that we have been forest-spendthrifts, and that it is about for us to begin economizing, and if possible repair our wasted pat- ny. There is a vague fear that certain dangers are impending over s a penalty for recklessly clearing the timber lands, and there seems a very general wish that our neighbors should do something at once. , what to do and how to do it are not so clear.

a course of lectures last winter at the Lowell Institute, Dr. Hough a frank statement of the difficulties. In the Eastern States the tra- ns of two hundred years are against tree-planting; there is no con- of action in any community; there are many contingencies which render the scheme in any one case a very hazardous one, and there all events, a long time to wait for any pecuniary profit.

sides these difficulties we may state another, namely, that in few s are the assessors of taxes in a right frame of mind. And so each would gladly see his neighbor do something at once. This little hlet by Mr. Sargent gives many sensible hints as to what to do, e call attention to the paper because it is a practical one, advo- practicable methods. Meanwhile, as our communities are acting ofessor Northrop's suggestion to plant centennial trees in the towns ear, can they not try a few centennial forests?

Pflanzenwelt Norwegens.[2] — This work is in two parts. rst, published in 1873, is a general account of the physical features rway and Sweden, with particular reference to the distribution of wild plants and the cultivation of the useful ones. The second part bears the date 1875 and is more special in its nature, being in fact a popular flora of Scandinavia. The volumes are interesting throughout. We shall hope to transfer to our General Notes some of Professor Schübeler's statements respecting the remarkable climate of Norway, and the occurrence of Southern plants near the Arctic circle.

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[1] *Few Suggestions on Tree-Planting.* By C. S. Sargent, A. B., Director of the Arboretum of Harvard University. From Report of Massachusetts State of Agriculture, 1875.

[2] *Pflanzenwelt Norwegens.* Von Dr. F. C. Schübeler. (The Vegetation of y, by Professor Schübeler, of the University in Christiania.)

BOTANISCHER JAHRESBERICHT.[1] — Annual Report on Botany, by Dr. Just, of Carlsruhe. The second year of this valuable compendium is an improvement on the first. The several departments of botany are conducted by different men, chiefly specialists, and in a careful manner. The articles which have appeared in the journals, and proceedings of societies, are given in abstract. Besides these there are very good critiques of the botanical books for the year (1874). The Year-Book is of great value to all botanists who wish to keep up with the published researches, and who have not time to study all the journals. It must be said, moreover, that the range of periodicals from which Dr. Just and his associates have selected their notes is very wide, comprising many chemical and agricultural journals, which are not likely ordinarily to fall in a botanist's way. Technologists and chemists have had their annuals for several years, and it is high time that botanists should fare as well. Botanists ought to congratulate themselves that the task has fallen into such good hands, and they should see to it that the enterprise is sustained.

KNEELAND'S AMERICAN IN ICELAND.[2] — This little book, issued about the same time as Judge Caton's Summer in Norway, affords fresh evidence that American tourists are taking more interest than formerly in Northern Europe, particularly the Scandinavian peninsula and the islands to the westward, the homes of the Northmen. Dr. Kneeland's book is an intelligent and by no means dull account of Iceland, preceded by pleasant sketches of the Orkney, Shetland, and Faroe Islands, as seen during a voyage of a few weeks in 1874, the year of the thousandth anniversary of the settlement of Iceland by the Northmen.

Our readers will examine with much interest the chapter on the Physical Characters of Iceland, in which the author adopts the view that Iceland was uplifted towards the end of the glacial epoch, and that this explains the traces of a milder climate in Greenland before the advent of man. At present the geographical position of Iceland is therefore very important, as "with Jan Meyen and Spitzbergen it forms a natural barrier against the desolation of Northern Europe by the ice from Arctic regions; should Iceland disappear beneath the waters, Nor-y would have the cold of Greenland, the north of England would come frozen, and Greenland would be green again."

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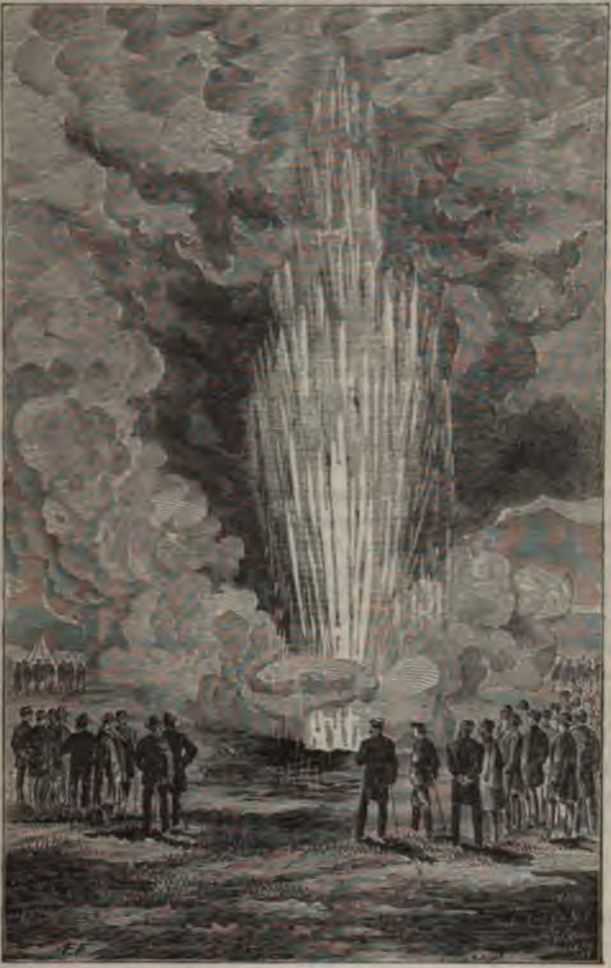
[1] Berlin: Gebrüder Bornträger, 1875, 1876.

[2] *An American in Iceland.* An Account of its Scenery, People, and History. With a Description of its Millennial Celebration in August, 1874; with Notes on the Orkney, Shetland, and Faroe Islands, and the Great Eruption of 1874. By SAMUEL KNEELAND. With Map and Nineteen Illustrations. Boston: Lockwood, Brooks, & Co. 1876. 12mo, pp. 326. $2.50.

Now that we have in Montana the Yellowstone Park, with its hun-ds of geysers, some throwing loftier streams than the Great Geyser Iceland, which sends a shower not over one hundred feet high, the ukadaly Valley of Iceland must hereafter assume a more modest ce in our geographies. But for many years more travelers will see



ERUPTION OF STROKR, AUG. 5, 1874.

(FIG. 18.)

geyser of Iceland than those of Montana. Our figure (18), kindly ned by the publishers, illustrates the Strokr or "churn" geyser, after as been irritated "by pouring a cart-load of sods down its capacious throat." The column of water is about one hundred feet high, and while the geyser is recovering from the effects of this novel emetic we leave the subject of Iceland and its sensitive interior.

HASSARD'S FLORAL DECORATIONS.[1] — This little manual seems to us to be quite novel in some of its features, and certainly very attractive. It will afford many a new suggestion, and the hints are in good taste. We select the titles of a few chapters to give some idea of the scope of the work: Preparing Flowers, Wiring Flowers, Gumming Flowers, Keeping Prepared Flowers Fresh; Plants through the Table, Decorations for Buffets; Table Decorations for Christmas Day; Arrangement of Fruit for Dessert; Vases for the Breakfast-Table; Vases for the Drawing-Room; Button-Hole Bouquets and Coat Flowers; Pot Plants in Rooms; Window Gardening, Hanging-Baskets, Fern-Cases, Stands of Plants; Plant-Stands for Halls; The Grouping of Plants in Rooms.

RECENT BOOKS AND PAMPHLETS. — Myths of the New World. By D. G. Brinton. Second Edition, revised, from New Plates. New York: Henry Holt & Co. 8vo. $2.50.

Angola and the River Congo. By Joachim John Monteiro. With Map and Illustrations. New York: Macmillan & Co. 1876. 12mo, pp. 354. $2.50.

Contributions à l'Histoire de la Vésicule germinative et du premier Noyau embryonnaire. Par Édouard van Beneden. Bruxelles. 1876. 8vo, pp. 50. With a Plate.

Beobachtungen über die Arten der Blatt und Holzwespen. Von C. G. A. Brischke und Dr. G. Zaddach. 4to, pp. 23–89. 1875. With Three Plates.

Birds. (From the Encyclopædia Britannica, ninth edition, iii. 728–778.) By Alfred Newton. 4to.

Geological Survey of Alabama. Report of Progress for 1875. By E. A. Smith. Montgomery, Alabama. 1876. 8vo, pp. 220.

Geological Survey of New Jersey. Annual Report of the State Geologist for the Year 1875. By Geo. H. Cooke. Trenton. 1875. 8vo, pp. 41. With a Map.

The Affinity of the Mollusca and Molluscoida. By W. K. Brooks. (From the Proceedings of the Boston Society of Natural History, xviii. 225–235, 1876.)

Botanical Articles. By Prof. W. G. Farlow. Extracted from the Bulletin of the Bussey Institution, March, 1876. 8vo, pp. 404–454. With Six Plates.

Bulletin of the United States Geological and Geographical Survey of the Territories. Vol. ii., No. 2, Art. 1. Studies of the American Falconidæ. By Robert Ridgway. Art. 2. Ornithology of Guadaloupe Island. By Robert Ridgway. Washington, D. C. April 1, 1876. 8vo, pp. 91–195. With Two Plates.

Notes on the Locust Invasion of 1874, in Manitoba and the Northwest Territories. By G. M. Dawson. Montreal. 1876. 8vo, pp. 16. (From the Canadian Naturalist.)

Bulletin of the Museum of Comparative Zoölogy. Vol. iii., Nos. 11–14. Cambridge. March 27, 1876. 8vo, pp. 273–348.

Transactions of the Kansas Academy of Science. Vol. iv. Topeka. 1875. 8vo, pp. 63.

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[1] *Floral Decorations for the Dwelling-House.* A Practical Guide to the Home Arrangements of Plants and Flowers. By ANNIE HASSARD. American Edition, revised. With many Illustrations. London and New York: Macmillan & Co. 1876. 12mo, pp. 166. $1.75.

GENERAL NOTES.

BOTANY.[1]

ON THE RATE OF MOVEMENT OF WATER IN PLANTS. — This subject been frequently investigated since the time of Hales and Bonnet. fessor Sachs, of Würzburg, gave, as the result of his observations, rate of 23 centimetres an hour. McNab, in 1871, made use of a tion of a salt of lithium, and traced it in its course through the nt, coming to the conclusion that the rate was 46 centimetres an hour. se values are regarded by Sachs himself and others as too low. The hods are regarded by Professor Pfitzer, of Heidelberg, as unsatisfac- , and he suggested in 1873 another which yielded very remarkable lts. He allowed the soil in some flower-pots containing plants to so far as to cause drooping of the leaves. Then he noted the posi- of the leaves by means of needle points, and watered the soil freely. leaves recovered their former positions rapidly, and the times were rved. The rate of 5 metres an hour was the highest noted. In *icia Adhatoda* leaves 25½ centimetres above the ground moved in e minutes after the soil was watered. In 1874 McNab repeated the um experiments and obtained a higher rate than before, nearly 40 es in the hour. Looking upon this as too low, Pfitzer has again ex- nented, this time with lithium nitrate. The water employed con- d one half of one per cent. of the salt. The plants used were cut r the solution, and the cut end immersed therein for a while. Upon val the plant was cut in lateral halves from above downward, and parts were tested spectroscopically. Twigs of Philadelphus gave Amarantus 6, and Helianthus 10 metres in the hour. The highest observed was in the case of a sunflower with leaves in bright sun- ; here it was 22 metres in the hour. The results of later observa- are promised.

E INFLUENCE OF LIGHT ON THE COLOR OF FLOWERS. — It was by Sachs a dozen years ago that the blossoms of many plants can op normally in perfect darkness. Plants which have a good supply borated material stored up in bulbs or tubers were observed to flowers of normal shape and color, even when all the leaves had and the flower-buds opened in a dark room. If the buds are ed in opaque cases, but the leaves exposed to sunlight so that lation is unhindered, the color and shape of the flowers remain l. There were noticed by Sachs a few slight exceptions. Com- asturtium blooming in the dark had flowers more yellow than usual; ower had smaller and brighter yellow blossoms than those which l in the light; scarlet-runner, brilliant flesh-red flowers; large agon, usually having flowers of deepest red, had, when blooming dark, corollas which were white blotched with rose, and on the lower lip had a sulphur-yellow spot. Sorby, in 1873, showed by the spectroscope that diminution in the amount of light prevents the formation of red coloring matter in the corolla of wall-flower, and changes the character of the yellow coloring matter. Askenasy was familiar with these facts last summer when he commenced a series of experiments, the results of which have just been published. He concludes that many flowers need the light in order to acquire their normal color, but others are quite independent of it. This difference may be referred in some cases to defective nourishment of the plant kept in darkness, but this cannot explain all. The observations can be so easily made that we suggest to our readers a repetition of some of the experiments. The plants which gave the most striking results were *Prunella*, *Silene*, *Antirrhinum*, *Pulmonaria*, *Hyacinthus*, and *Tulipa*.

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[1] Conducted by PROF. G. L. GOODALE.

TOLMIÆA MENZIESII, of Oregon (a curious rather than handsome saxifrageous plant, related to *Tiarella*), propagates naturally and freely by adventitious buds, produced at the junction of the leaf-stalk with the blade, in the manner of *Begonia*. We have five live plants that show this, sent by Elihu Hall, of Illinois, who calls our attention to the peculiarity. He states that any of the leaves may be taken off and used successfully for propagation. — A. GRAY.

MR. W. F. FLINT sends good specimens of *Astragalus Robbinsii* Gray, from the limestone region about Queechy, N. H.

RATE OF GROWTH OF AGAVE SCAPES. — July 10, 1870. I measured a scape of *Agave sisalensis* to-day, and made two transverse slits with the point of my knife, six inches apart, one above the other, and not far from tip of scape.

July 17th. The tip of scape is to-day 41½ inches higher than it was on the 10th, and the upper incision is 3½ inches and the lower one ⅞ of an inch higher than they were on same day.

July 22d. Three other plants measured to-day, whose scapes are respectively 30, 20, and 16 inches high.

July 25th. In the last seventy-two hours the scapes have grown in height 17⅞, 12¼, and 10½ inches, respectively.

Two transverse incisions were made, one 13¼ inches from the apex of scape, the other 18 inches below this; the upper one has ascended 3½ inches, and the lower one but $\frac{3}{16}$ of an inch.

July 29th. Scape of No. 1 has ascended (its tip) in the last six days 39 inches, and No. 2, 24 inches. (No. 3 was not measured.)

August 5th. Tip of scape of No. 1 has ascended in fourteen days 71 inches, and No. 2, 70 inches.

August 22d. No. 1 has, in thirty-one days, ascended 12 feet and three inches, and No. 2, 12 feet and two inches. — N. B. MOORE, Manatee. Fla.

THE TEETH OF GREEN LEAVES AS ORGANS FOR THE SECRETION OF NECTAR. — The fact that green leaves secrete a saccharine matter

s been known since the announcement by Conrad Sprengel, in the
t century, that on the stipules of certain *Vicias* there are secreting spots.
hlechtendal, in 1844, described the secretion of "sugar" by the leaves
Clerodendron and *Viburnum Tinus.* Unger noticed "sugar-glands" on
se and on *Acacia longifolia.* Caspary found similar glands on many
nts, but it appears to have been Haustein who first thoroughly inves-
ated their structure. He thought the glands were in most cases mod-
d trichomes or plant-hairs. Reinke has lately reviewed the whole
ject, and finds that in addition to the sugar-spots and sugar-hairs
re are also modified serrations of the leaf-blade in many plants,
ich serve as organs for secreting matters; in some cases the exuda-
n is of a saccharine character, but often of a mucilaginous nature.
unus Avium and some other species of *Prunus, Kerria Japonica,*
sa centifolia, Cydonia Japonica, Betula alba, and many other plants
spoken of in his memoir as possessing leaf-teeth which secrete freely.
few plates accompany Reinke's paper.

BOTANICAL PAPERS IN RECENT PERIODICALS. — *The Journal of*
tany, British and Foreign, March, 1876. On New and Rare Fungi,
W. G. Smith, F. L. S. Two New *Amaryllidaceæ* from Natal, by J.
Baker, F. L. S. On the Genus *Syringodea* (in Order *Iridaceæ*), by
G. Baker, F. L. S. The Apetalous Fuchsias of South America, by
B. Helmsley. Some Contributions to Plant-Chemistry, by A. H.
rch. (Analyses of lettuce, Irish moss, water-cress, beech-scales, elm-
vers, outer layers of wheat-grain.) A list of new species of flowering
ts in periodicals published in Great Britain during 1875.

Proceedings of the Royal Irish Academy, January, 1875. On Heat as
Factor in Vital Action (so-called), by Geo. Sigerson, M. D. (Con-
ning the effect of heat on cyclosis, etc., and on the motion of latex.)
ril, 1875. On the Apothecia of certain Algæ, by William Archer.
a new Fresh-Water Sarcodic Organism, by William Archer. List
Seychelles Myrtaceæ, by J. G. Baker, July, 1875. On the Structure
he Leaves of certain Coniferæ, by Prof. W. R. McNab. (A reëx-
nation of the microscopic anatomy of the section *Tsuga* of the genus
us. With plate giving cross sections of the leaves of the six species.)

Botanical Bulletin (Hanover, Indiana), March, 1876. Chia, by Dr.
hrock. ("Chia" is a mealy preparation made from the roasted seeds
Salvia Columbariæ. The meal mixed with water is used as food and
demulcent drink. Quantities of this seed have been found buried
raves several hundred years old, a fact which indicates that its use is
reat antiquity.) Notes on Gramineæ, by A. H. Young.

Comptes rendus, No. 3. A. Müntz, On certain Changes in the Cane-
ar of Cane-Juice. No. 5. Heckel, On the Spontaneous Periodic
vement in the Stamens of *Saxifraga sarmentosa, umbrosa, Geum*
thifolia, and in *Parnassia palustris.* The relations of this phenom-
to the arrangement of the floral organs.

Flora, No. 2. Hugo de Vries, On Wood-Tissue which repairs Wounds (not finished). A. Geheeb, On certain Mosses. No. 3. A. de Krembelhuber, Brazilian Lichens. Hugo de Vries, On Wood which repairs Wounds (not finished). Stephan Schulzer, Notes on Fungi. No. 4. Continuations of the foregoing.

Botanische Zeitung. Reinke's paper on Investigation of Growth is continued in the numbers since our last notice, and down to No. 10, March 10th. The paper is of great interest, and will be noticed at some length in the June NATURALIST.

ARBEITEN DES BOTANISCHEN INSTITUTS IN WÜRZBURG, herausgegeben von Professor Dr. Julius Sachs. We resume our notice of this volume of Botanical Contributions from the Würzburg Laboratory with the third part, which begins with a paper by Dr. Hugo de Vries, On the Wilting of Cut Shoots. (De Vries has clearly pointed out the marked difference in effect between cutting shoots under water and severing them with exposure of the cut surface to the air. The former shoots wither far less than the latter.) IX. Hugo de Vries, On Growth in Length of Tendrils which curve on the Upper or the Lower Side. (The effect of irritation to change the rapidity of growth is not local, but is felt in certain cases throughout the tendril. The effect is often continued after the removal of the irritant or the body in contact.) X. Hugo de Vries, On the Mechanics of Living Plants. (Abstract given in Sachs' Text-Book, page 777.) XI. Dr. Emil Godlewski, Dependence of the Elimination of Oxygen from Leaves on the Amount of Carbonic Acid in the Air. (1. Increase in the amount of CO_2 in the air up to a certain limit favors the evolution of oxygen; above this limit it is more or less injurious. 2. This limit varies for different plants: for *Glyceria spectabilis* on clear days, between eight and ten per cent.; for *Typha latifolia*, between five and seven per cent.; for oleander a little lower. . . . 5. Increase in intensity of the light increases the evolution of oxygen.) XII. Dr. K. Prantl, On the Influence of Light on the Growth of Leaves. (Attributing the difference between growth in light and growth in darkness to the pathological condition induced by absence of light.) XIII. and XIX. Professor Sachs, On the Growth of Tap and Side Roots. (An interesting and elaborate memoir, to be hereafter given in abstract in our General Notes.) XIV. Dr. Hermann Müller (Thurgau), On the Protonema and Rhizoids (root-hairs) of Mosses. XV. Dr. Oscar Brefeld, On Alcoholic Fermentation. XVI. Dr. Hugo de Vries, On the Extensibility of Growing Shoots. XVII. Dr. K. Prantl, On the Renewal of the Growing Point in the Roots of Angiosperms. XVIII. Dr. R. Pedersen, Have Variations in Temperature, as such, an Unfavorable Influence on Growth? (Answered in the negative.)

In closing this sketch of the first volume of Contributions from the Würzburg Laboratory, we must be allowed to call attention to an important and excellent feature of the publication, namely, the summary at

ıe end of each article. This has long been the practice of French
riters. Its adoption in a work like this gives an increased value which
e are all quite ready to appreciate. Furthermore, we must refer to the
nerally impartial historical outlines which are prefixed to the separate
emoirs. Even a busy reader can see what has been done before, and
hat the upshot of each paper is.

ZOÖLOGY.

ARE POTATO BEETLES POISONOUS? — Although I have made no in-
stigations regarding the poisonous nature of the Colorado potato bug,
d am prejudiced neither *pro* nor *con*, the experiments of Messrs.
ote and Keyser as stated in the April NATURALIST do not seem con-
sive to me. I should not consider the innoxious nature of the *Dory-*
ora proven. Since heat changes many organic substances, it is not im-
sible that the "liquid" of their experiments may differ entirely from
juices of the living beetle. Their hypodermic injections would seem
prove the idea (if I understand their account correctly) that the beetles
possess some toxical properties. The heart of a frog separated from
body often beats for a longer period than that recorded in their ar-
e. Another possible source of error lies in the animal employed in
ir investigations. All animals are not equally susceptible to the action
poisons. Man is more so than the lower vertebrates, and they even
er among themselves in this respect. Thus it may be that the beetles
e qualities injurious to man, while they have no effect on frogs and
ls.

n the above remarks I have not endeavored to prove the poisonous
lities of the beetles, but to express my reasons for denying the co-
cy of the reasoning employed in the article referred to, and to turn
attention of other investigators to the subject. — J. S. KINGSLEY.

'HE LABRADOR DUCK. — H. E. Dresser, Esq., the well-known orni-
ogist, author of the Birds of Europe, is desirous of obtaining informa-
respecting this bird (*Camptolæmus Labradorius*), such as its geo-
hical distribution (past and present), anything tending to elucidate
habits, and, in particular, a list of the specimens known to be pre-
ed in United States collections. In this last matter, will the custo-
s of collections in which the bird is represented kindly interest them-
s? Mr. Dresser furthermore authorizes me to offer £40 ($200,
), for a pair, male and female, in good order. Communications may
ddressed to him, No. 6 Tenterden Street, Hanover Square, London,
or to the undersigned. — ELLIOTT COUES, Smithsonian Institution,
hington, D. C.

HE COTTON WORM. — Mr. Grote, in the last Alabama Geological
ort, states his belief that the cotton worm is an imported insect and
ndigenous to the Southern States. In Alabama it does not appear
ne plants before June or July.

ANTHROPOLOGY.

ANTHROPOLOGICAL NOTES. — Under the editorial supervision of Mr. Edward Arber, of London, a volume of great interest will appear during the coming season. It will be a reprint of the first three English books on America. The first was printed at Antwerp by John of Doesborowe, about 1511, a book "of the new Landes, and of the People founde by the Messengers of the Kynge of Portyngale, named Emanuel." The second is a translated extract from the Cosmographia (1540) of Sebastian Muenster, professor of Hebrew at the University of Basle, entitled A Treatese of the Newe India, with other new founde Landes and Islandes as well Eastwarde as Westwarde, as they are known and founde in these our days, etc. The third is a collection of the first English Voyages, Traffics, and Discoveries, containing Peter Martyr's Decades, and other interesting articles.

The attention of anthropologists is most earnestly directed to the circular letter of the anthropological subsection of the American Association for the Advancement of Science, inviting them to attend the meeting to be held in Buffalo the present year, prepared to read papers on interesting subjects.

Messrs. Macmillan have in press a volume by Mr. E. G. Squier, being "Incidents of Travel and Explorations in the Land of the Incas."

Correspondenz-Blatt of January 1st has a supplement containing a catalogue of all the public and private collections of ethnological, anthropological, and prehistorical collections in Germany. The Smithsonian Institution commenced such a catalogue for all branches of scientific study within the United States, some time ago, and many hundreds have responded to their circular.

The fourth number of *Revue d'Anthropologie* comes to us with an unusually interesting collection of articles. The principal ones are Recherches sur l'Indice Orbetaire, by Paul Broca; Ethnogénie des Populations du Nord-Ouest de la France, by Gustave Lagneau; Origine du Bronze, by G. de Mortillet; Le Feu chez les Peuplades primitives, by Mme. Clemence Royer.

The contents of the twelfth number of Matériaux pour l'Histoire primitive et naturelle de l'Homme are of a more special character. The drawing of the royal tomb of Koaloba, in the Crimea, possesses much interest.

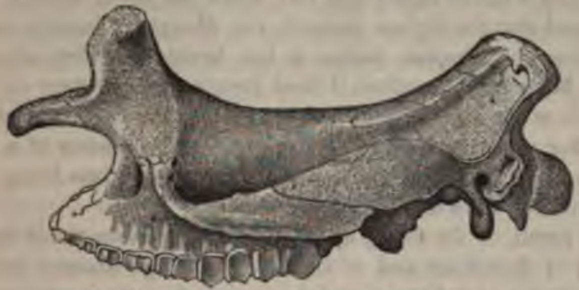
A very interesting paper was read before the British Scandinavian Society, January 18th, on some recent discoveries of tumuli belonging to the viking age. Among other objects a boat eighty feet long and eighteen wide, with high prow, is like some now used in certain parts of the Norwegian coast.

Lieutenant-Colonel Playfair reports the discovery at Aurès, in Algiers, of Roman ruins of the most magnificent character. The inhabitants bear unmistakable testimony to the classic origin of their features, language, d customs. Many remains of Roman edifices, some of them crowned th Byzantine structures, were found. The full account is in a Blue ok, just issued, of consular reports to the Foreign Office, London.

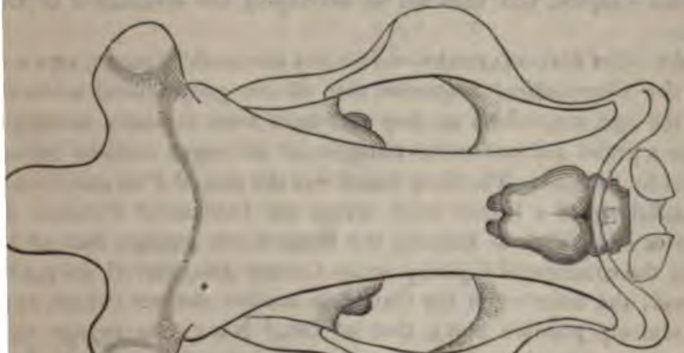
Dr. Hooker is in receipt of a private letter describing the warlike bits of the Papuans. No man leaves his dwelling for his bit of cultited land, even, without his powerful bamboo bow and a few deadly poied arrows. These are pointed and barbed with human bone, brought almost needle-like sharpness, and most carefully and neatly finished. ey are poisoned by being plunged in a human corpse for several days. O. T. MASON.

GEOLOGY AND PALÆONTOLOGY.

IGANTIC MAMMALS OF THE ROCKY MOUNTAINS. — We have aldy (page 182) called attention to Professor Marsh's discovery of the arkably small brain of the *Dinocerata*, a group of large tertiary mals of the West. In the *American Journal of Science and Arts* April, he discusses the principal characters of the *Brontotheridæ*,



(FIG. 19.) SKULL OF BRONTOTHERIUM INGENS.
Side view; one twelfth natural size.



20.) OUTLINE OF SKULL AND BRAIN CAVITY OF BRONTOTHERIUM INGENS.
Top view; one tenth natural size.

which were mammals nearly equaling the elephant in size, but with shorter limbs, and with a flexible nose as in the tapir, but no true proboscis. They lived in the lake basins of Dakota, Nebraska, Wyoming, and Colorado in the early Miocene Tertiary period. Figure 19 represents a side view of the skull of *Brontotherium ingens* Marsh, one twelfth of the natural size, and Figure 20 is an outline of the skull and brain cavity of the same animal, one tenth of its natural size, showing the remarkably small size of the brain. On the plates are views of different parts of the skeleton and of casts of the brain cavity.

GEOGRAPHY AND EXPLORATION.

Is it Possible to Unite the Black Sea and the Caspian? — Major Wood answers this question in the affirmative in the *Geographical Magazine* for February. He says that though the present level of the Caspian Sea is about eighty-four feet below the ocean level, it must be remembered that the highest point in the Manytch Channel, connecting the Euxine and Caspian basins, is but twenty-four feet above ocean level. "Manifestly, therefore, if these twenty-four feet were cut through, the waters of the Sea of Azof would pass into the Caspian basin and fill it up. Nor would such an enterprise present the shadow of a difficulty to the engineering genius which has already brought into being the great excavators that were used on the Suez Canal.

"The result of the filling up of the Caspian basin would be the destruction of Astrakhan and of all other buildings situated below ocean level on the Caspian littoral, and the project therefore would not appear at first sight to be a desirable one." Its execution would increase the water-spread of the Caspian from an area of 140,000 square miles to one of 250,000 square miles, and provide an ocean route to the eastern shore of the Caspian, and thus aid in developing the civilization of Central Asia.

Ancient Geographers. — It is not too much to assert, says a writer in the *Geographical Magazine*, that all the geographical achievements of the age, stupendous as they are, have been virtually nothing more than a grand and successful filling-in of the vague outlines bequeathed to us by the past. The Suez Canal was the idea of Pharaoh-Necho; the establishing of a beaten track across the Isthmus of Panama, that of Cortez and Nuñez de Balboa; the Mont Cenis passage, that of Hannibal; the commercial highway across Central Asia, that of Alexander the Great; the diverting of the Oxus into another channel (which, however, is scarcely possible now), that of Octai Khan; the voyage eastward round the cape, that of Xerxes; the search for the source of the Nile, that of half a dozen Egyptian kings, as well as of their conqueror, Cambyses, centuries before the Christian era; the existence of great inland seas in South Africa, that of the Portuguese explorers of the sixteenth

tury, some of whom, if we are not mistaken, have got more than one
these new "discoveries" of ours marked on their maps! In short,
may say with the Irish school-master, when he found one of his own
iles in Homer, "Curse thim ancients, they 've stolen all our best
as!"

NUNDATION OF THE SAHARA. — The idea of converting the Western
hara into an inland sea is discountenanced by Mr. E. G. Ravenstein,
o thinks that the plan is premature. He claims that the natural out-
of the Sahara are Tripoli, Algiers, Morocco on the north, the Atlan-
seaboard on the west, and the Senegal and Niger on the south. "It
y these roads the necessities of the inhabitants of the Sahara are
plied, and their surplus produce is exported, and they will suffice for
ng time to come."

AP OF PREHISTORIC RUINS IN COLORADO. — A Preliminary Map
Southwestern Colorado and Parts of the Adjacent Territories, show-
the Location of Ancient Ruins, issued by the United States Geolog-
and Geographical Survey of the Territories, F. V. Hayden in charge,
be found of much use by archæologists and travelers, as it gives the
lities of the ancient rock ruins and cliff-houses discovered by the sur-

MICROSCOPY.[1]

AN FRANCISCO MICROSCOPICAL SOCIETY. — This working society
numbers about forty active members, and its annual receptions and
-monthly meetings are well sustained. During the past year it has
menced the formation, by purchase and donation of books and sub-
tions to magazines, of a suitable library, and has added to its supply
pparatus a Nachet microscope whose one-eighth objective, which has
ollar adjustment, with Nachet's oblique condenser, resolved promptly
easily into beads No. 19 of Möller's test-plate. Among the nota-
dditions to the cabinet of slides are a series of slides of the wall
of the gold-bearing veins of California; a series of sections of
woods of California; a slide of the curious diatom, *Schizonema*
illii, remarkable for its great external resemblance to some forms of
the frustules of which were contained in a regular tubular frond,
ich they were living when found, and up and down the canal of
they were seen to move; a slide of crystals of salt obtained by
evaporation from the tear of a child; and a fragment of photo-
ic paper mounted in balsam to exhibit the minute specks which are
noying to the photographer, and which appeared as white spots con-
g a dark nucleus of an arborescent crystalline formation, black
of manganese being believed to be the cause of the spots, and
chloric acid being suggested as a possible means of removing them.
vork of the society seems to be mainly directed to the legitimate
l history applications of the microscope, though not without some

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[1] This department is conducted by DR. R. H. WARD, Troy, N. Y.

such diversions as public exhibitions and a moderate amount of "microscopic gymnastics" in the way of "test-object" resolution. Mr. Kinne's paper on the method by which a fly walks in an inverted position was brought so strongly before the attention of the publishers of a school-book in which the familiar facts of the case were misrepresented, that they promised to suppress the erroneous article in future editions. The excellent annual address of the president, Prof. Wm. Ashburner, recommends that, in addition to the advantages furnished to members, the privileges of the rooms be extended to investigators who might not be able to incur the expense of regular membership.

KINNE'S TURN-TABLE. — This is a self-centring table in which the object is held diagonally between rectangular clutches, as in the "Cox table." This was contrived independently, though published subsequently to Mr. Cox's invention, from which it differs in moving the clutches by a lever and spiral instead of a screw.

COMPARATIVE PHOTOGRAPHS OF BLOOD. — Dr. J. G. Richardson, for the sake of illustrating in criminal cases the distinguishable appearances of different kinds of blood, has flowed drops of blood from different animals so nearly in contact on the glass slide that portions of the two drops appear in the same field and can be photographed together. Dr. C. Leo Mees has modified this method and obtained exquisite results in specimens presented to the microscopical section of the Tyndall Association. He spreads the blood by Dr. Christopher Johnson's method, which is to touch a drop of blood to the accurately ground edge of a slide, and then draw it gently across the face of another slide, leaving a beautifully spread film. In this way one kind of blood is spread upon the slide and another on the cover. When dry, one half of each is carefully scraped off with a smoothly sharpened knife, and the cover inverted upon the slide in such position as to bring the remaining portions of the film into apposition. Under the microscope and in the photograph the two kinds of blood appear in remarkably fine contrast, even those bloods that are too nearly alike for safe discrimination in criminal cases being easily distinguished when thus prepared from fresh material.

"RUSTY GOLD." — Mr. Melville Attwood, in his paper on this subject before the San Francisco Microscopical Society, discredits the belief of the miners that a thin film of oxide of iron forms on gold and prevents a successful separation of the gold by means of amalgamation. He believes the failure of the miners to obtain good results to be due far more to an unexpected poverty of the quartz than to any difficulty in causing the quicksilver to combine with the gold that is really present.

EXCHANGES. — (Notices, not exceeding four lines in length, of microscopical objects or apparatus wanted or offered in exchange, not sale, will be inserted in this column without expense.)

Diatoms, prepared or unprepared, in exchange for others. Correspondence desired with amateurs interested in mounting arranged dia-

ns. — Galloway C. Morris, Tulpehocken Street, Germantown, Phila-
phia, Penn.

Magic-lantern transparencies or cabinet-size photographs of micro-
pic objects in exchange for suitable slides. — R. H. Bliven, Elmore,
io.

POLARIZING CRYSTALLIZATIONS. — Mr. C. C. Merriman, of Roches-
gives the following useful hints in regard to the preparation of the
uisite polarizing objects contributed by him to the Postal Micro-Cabi-
Club: "All solutions must be in distilled water, and carefully fil-
d. Solution of gum arabic must be added to the crystalline solution
il the drops will dry on the slide without crystallizing. Then the
p on the slide is to be held over steam until one or more points of
tallization appear; then at once dried over an alcohol lamp; then
l over the steam again until the crystals have grown a trifle larger,
so on until the specimen is satisfactory. The specimens are to be
varnished over with a film of collodion, such as photographers use,
then mounted in old Canada balsam." Specimens thus prepared
been perfectly preserved for many years, though some of them are
led by re-crystallization after mounting.

MERICAN MICROSCOPICAL SOCIETIES. — The following list of
oscopical organizations is corrected to date, with the exception of a
instances, where further information could not be obtained. Secre-
s and others interested are specially requested to furnish such cor-
ons and additions as may become necessary from time to time.

gassiz Institute, Sacramento, Cal. Organized 1872. Meets second
day evening of month. President, —— ——; Vice-President,
I. E. Dwinell, D. D.; Secretary, A. P. Andrews; Cor. Secretary,
J. H. C. Bronte.

cademy of Natural Sciences, Philadelphia; Biological and Micro-
cal Section. Organized 1868. Meets first Monday evening of the
h, except July and August, in the hall of the Academy, cor. 19th
Race sts. Director, W. S. W. Ruschenberger, M. D.; Vice-Di-
r, James Tyson, M. D.; Recorder, J. G. Richardson, M. D., 1835
tnut St.; Cor. Secretary, J. H. McQuillen, M. D.; Treasurer, Isaac
is, M. D.; Conservator, J. Gibbons Hunt, M. D.

nerican Association for the Advancement of Science; Microscopical
Section. Has met occasionally in connection with the migratory
ns of the association. It is intended to organize permanently at
uffalo meeting next August.

erican Microscopical Society of the City of New York. Organized
Meets second and fourth Tuesday evenings of the month, at 35
10th St. President, John B. Rich, M. D.; Vice-President, Will
I. Atkinson, M. D.; Secretary, C. F. Cox, 13 William St.; Treas
T. d'Orémieulx; Curator, O. G. Mason.

erican Postal Micro-Cabinet Club. Organized 1875. Business conducted exclusively by mail. President, Prof. John Peirce, Providence, R. I.; Secretary, Rev. A. B. Hervey, 10 North Second St., Troy, N. Y.; Managers, R. H. Ward, M. D., Troy, N. Y., and C. M. Vorce, Cleveland, Ohio.

Bailey Club, New York city. A small club of working microscopists. Meetings informal, every second Tuesday, at residences of members.

Boston Microscopical Society. Organized 1873. Meets first and third Thursdays of month, at residences of members. President, David Hunt, Jr., M. D.; Vice-Presidents, Stephen P. Sharples, S. B., and Alfred F. Holt, M. D.; Secretary and Treasurer, R. R. Andrews, D. D. S., Brattle Square, Cambridge, Mass.; Council, S. W. Creech, Jr., J. Frank Brown, and Edward Moulton; Custodian, C. H. Osgood, D. D. S.

Boston Society of Natural History; Microscopical Section. Organized 1864. Meets second Wednesday evening of month. Committee, Edwin Bicknell, R. C. Greenleaf, and B. Joy Jeffries, M. D.

Buffalo Microscopical Club, Buffalo, N. Y. Organized 1876. President, Prof. George Hadley, M. D.; Secretary, James W. Ward; Advisory Council, H. R. Hopkins, M. D., Henry Mills, and Prof. D. R. Kellicott.

Dartmouth Microscopical Club, Hanover, N. H. Organized 1870. President, Prof. E. Phelps; Vice-President, Prof. L. B. Hall; Cor. Secretary, Hiram A. Cutting, M. D., Lunenburgh, Vt.

Denver Microscopical Society.

Dunkirk Microscopical Society, Dunkirk, N. Y. Organized 1874. Meets second Friday evening of month. President, George E. Blackham, M. D.; Secretary and Treasurer, M. E. C. Shelton.

Fairmount Microscopical Society, Philadelphia. Organized 1871. Meets third Thursday evening of month. President, S. H. Griffith, M. D.; Secretary and Treasurer, William C. Stevenson, Jr., 24 South 4th St.; Managers, Jno. Gordon Gray, E. O. Shakespeare, M. D., and B. F. Quimby.

Indiana Microscopical Society, Indianapolis, Ind. Organized 1874. Meets first Friday evening of month, at residences of members. President, William B. Fletcher, M. D.; Secretary and Treasurer, E. Hadley, M. D., 191 Va. Ave.

Jamestown Microscopical Society.

Kirtland Society of Natural History, Cleveland, Ohio; Microscopical Branch. Secretary, John Bowers.

Louisville Microscopical Society, Louisville, Ky. Organized 1874. Meets first and third Thursday evenings of month. President, Prof. J. Lawrence Smith; Vice-Presidents, Noble Butler and C. F. Carpenter, M. D.; Treasurer, C. J. F. Allen; Secretary, John Williamson; Cor. Secretary, E. S. Crosier, M. D.

Maryland Academy of Sciences, Baltimore, Md.; Section of Biology and Microscopy. Organized 1874. Meets first and third Wednesday

venings of month, at Academy Buildings, Mulberry St. Chairman, B.
V. Barton, M. D.; Secretary, W. G. Harrison, M. D., 69 Centre St.

Memphis Microscopical Society, Memphis, Tenn. Organized 1874.
Meets first and third Thursday evenings of month, at 218 Main St.
President, S. P. Cutler, M. D.; Secretary and Treasurer, A. F. Dod,
57 Main St.

New Jersey Microscopical Society, New Brunswick, N. J. Organized
871. Meets second Monday evening of month at Rutgers College.
resident, Prof. F. C. Van Dyck; Rec. Secretary, Rev. Samuel Lock-
ood, Ph. D., Freehold, Monmouth Co., N. J.

Providence Franklin Society, Providence, R. I.; Microscopical De-
rtment. Organized 1874. Meets every second Wednesday evening
rooms in North Main St. President, Prof. Eli. W. Blake, Jr.; Vice-
resident, A. O. Tilden; Secretary, Prof. John Peirce; Treasurer, C. B.
hnson, M. D.; Librarian, N. N. Mason.

San Francisco Microscopical Society, San Francisco, Cal. Organized
72. Meets first and third Thursdays of month at 531 Cal. St.; Presi-
nt, Prof. William Ashburner; Vice-President, Henry C. Hyde; Rec.
cretary, C. Mason Kinne, 422 Cal. St.; Cor. Secretary, Charles W.
nks; Treasurer, Charles G. Ewing.

Society of Natural Sciences, Buffalo, N. Y.; Microscopical Section.
ganized 1872. Curator, Henry Mills, 162 Fargo Ave.

State Microscopical Society of Illinois, Chicago, Ill. Organized 1869.
ets second and fourth Fridays of month, at the Academy of Sciences.
esident, Henry W. Fuller; Secretary, B. W. Thomas; Cor. Secre-
y, Charles Adams; Treasurer, Geo. M. Higginson.

State Microscopical Society of Michigan, Kalamazoo, Mich. Presi-
nt, Rev. Dr. Foster.

Troy Scientific Association, Troy, N. Y.; Microscopical Section. Or-
ized 1870. Meets first Monday evening of month, except July and
gust, at residences of members. President, R. H. Ward, M. D.;
e-President, Rev. A. B. Hervey; Secretary, Prof. Arthur W. Bower.

Tyndall Association, Columbus, Ohio; Microscopical Section. Or-
ized 1874. Meets first and third Saturday evenings of month. Pres-
nt, Rev. I. F. Stidham; Secretary, C. Howard; Curator, M. Hensel.

THE LEEUWENHOEK MEDAL. — The first award under the provision
le at the two hundredth anniversary of the discovery of infusoria by
uwenhoek, for bestowing a medal in his honor upon distinguished
roscopists, has been received by the oldest European candidate, Pro-
or Ehrenberg, of Berlin.

NEW ADJUSTMENT FOR COX'S TURN-TABLE. — A slide may be, by
turn-table, centred for width only, by laying it on the table at right
les to the line of the spindle and placing triangles of brass, or even
lboard, between it and the clutches which are designed to hold the
ners of the slide. When thus arranged the slide may be slipped so

as to bring different parts of its median line successively to the centre of the apparatus, and thus a series of cells may be made upon the same slide, or any desired group of cells may be made by using a variety of unequal triangles. For common use the two triangles should be exactly alike, should be right-angled, and should have the sides adjoining the right angle one inch in length. Such pieces may be cut from sheet brass about the thickness of an ordinary glass object slide. These triangles may also be used, with the addition of a few cardboard blocks, for the purpose of decentring, in refinishing old slides that have not been accurately centred.

SCIENTIFIC NEWS.

— In the Seventh Annual Report of the American Museum of Natural History it is stated that the trustees have purchased Professor Hall's palæontological collection for $65,000, and Mr. Squier's rare collection of antiquities from South and Central America; $200,000 have been appropriated by the New York legislature for furnishing the magnificent new museum building on Manhattan Square. The number of visitors to the museum, still remaining in the old arsenal, averages 13,577 a week, the weekly average of visitors to the entire British Museum, embracing all the exhibition halls, being 11,574 in 1874.

— The Bulletin of the United States Geological and Geographical Survey of the Territories, vol. ii. No. 1, contains A Notice of the Ancient Remains of Southwestern Colorado, examined during the Summer of 1875, by W. H. Holmes; A Notice of the Ancient Ruins in Arizona and Utah lying about the Rio San Juan, by W. H. Jackson; The Human Remains found near the Ancient Ruins of Southwestern Colorado and New Mexico, by Dr. Emil Bessels.

— Mr. Grote's Check-List of the Owlet Moths or Noctuidæ of America, Part I., Bombyciæ and Noctuelitæ (Buffalo, N. Y., pp. 28), is a very useful catalogue. It is accompanied by a photograph illustrating several new species.

— From *The Round Table and Beloit Monthly* we learn that a bill has been passed by the legislature of Wisconsin appropriating $25,000 for printing the geological reports made during the past three years by he late Dr. Lapham and others, as well as those that shall be prepared by Professor Chamberlain, who has been appointed to complete the work. The New York *Nation* states that $10,000 has been appropriated by the same legislature for the purchase for the university of Dr. Lapham's collections and library. It also is to print for the Wisconsin Academy of Sciences a volume of transactions in alternate years.

— Professor Angelin, a Swedish geologist and palæontologist, died at Stockholm on the 13th of February, aged seventy.

— Prof. F. V. Hayden has been elected a member of the Imperial Society of Naturalists of Moscow.

— A course of summer instruction will be given at Bowdoin College, unswick, Maine, in chemistry and mineralogy by Professor Car- chael and Mr. Robinson, while botany will be taught by Mr. F. L. ribner. The Normal School of Natural History will hold a second sion at Normal, Illinois. Professors Gastman and Forbes are the ectors.

— The government of India is making arrangements for an archæo- ical survey of the whole country.

— Dr. A. B. Hoyt writes us from Grafton, N. H., that he saw a bull- g nearly swallow a common striped snake about one foot long. At time not more than five inches of the snake was out of the frog's uth.

— Baron von Nolken, of Riga, Russia, has gone with an assistant to gota for the purpose of collecting and observing insects. The micro- doptera that he collected there on his previous journey have been ribed by Professor Zeller, and the work will be published by the omological Society of Russia.

- Professor Alpheus Hyatt is now engaged in monographing dis- ed forms of fresh-water shells from the famous Tertiary locality of nheim, and desires to make comparisons with living or fossil shells other localities. He has already obtained shells in which the nor- spiral was more or less distorted or unwound, from two other locali- but wishes to obtain more extensive information, and offers in ex- ge suits of Steinheim shells, *Valvata* or *Planorbis multiformis*, with four to sixteen distinct varieties. Distorted forms have been here- e mostly found in perfectly still, inclosed basins of limited extent no outlet. Information with regard to similar localities is also ested. Address Society of Natural History, corner of Berkeley and ston streets, Boston, Mass.

Dr. Steindachner, the well-known ichthyologist, who spent some in this country studying the fishes of North and South America· ust been appointed director of the Imperial Zoölogical Museum at na, in place of Dr. Redtenbacher, lately deceased.

Mr. M. Tompkins, of Silver Islet, Ontario, Canada, writes us that s a female white pelican (*Pelecanus erythrorhynchus*) with a horny on the mandible as in that described by Professor Snow in the RALIST (ix. 665). It was shot by an Indian on the north shore ke Superior, near the old Hudson Bay Company's Post, Fort am, Thunder Bay.

At the last meeting of the American Academy of Arts and Sciences, William Everett read a paragraph from Æschylus' Prometheus ing, as he thought, to the river Zambesi, and showing that the s of a period before that of Herodotus had a more intimate ledge of the interior of Africa than they have had the credit for.

Haeckel has studied the development of the annelid worm, *Fabricia*, one of the family *Sabellidæ*, and finds that it passes through a true "gastrula" condition. This is the first time that this stage of development has been traced in the higher worms. In studying these embryos he used carmine and hæmatoxylin as staining agents, the embryo being rendered transparent by glycerine.

— Prof. E. Ray Lankester, in his abstract of Haeckel's article on the Gastræa theory, actually includes the Ascidians in the Vertebrates, adding in a foot-note that "Professor Haeckel is not responsible for the classification here adopted of the Tunicata under the great group of Vertebrata."

— To elicit facts as to the migration of birds, *Forest and Stream* proposes to each one of its readers the plan of noting down, in reference to the birds of his district, observations upon some or all of the following points: —

(1.) Whether each species is resident throughout the year, is a summer or winter visitor, or only passes through in spring and fall.

(2.) With reference to each species in his locality, whether it is "abundant," "somewhat common," or "rare."

(3.) What species breed, and whether more than once in a season.

(4.) Dates of arrival, greatest abundance, nest-building, laying eggs, hatching of young, and beginning of departure of each species, and when it is last seen in the fall.

(5.) What effect, if any, upon the relative abundance of particular birds, in retarding their arrival or hastening their departure, sudden changes of the weather, storms, and "late" and "early" seasons appear to have.

(6.) Similar notes upon the appearance and movements of the quadrupeds, reptiles, and fishes of the region; and upon the times of flowering of trees and plants.

(7.) Other occurrences considered noteworthy.

Among the birds most likely to be reported upon, and which are the best exponents of the laws of migration, are the following, and to them especial attention is asked: cat-bird, blue-bird, summer yellow-bird or yellow warbler, golden-crowned thrush, redstart, barn swallow, goldfinch or thistle-bird, song sparrow, chewink or towhee-finch, bobolink, red-winged blackbird, meadow lark, Baltimore oriole or hang-nest, phœbe-bird or bridge pewee, chimney swift or swallow, kingfisher, red-headed woodpecker, woodcock, killdeer plover, Wilson's snipe, white crane, wood duck, wild geese.

If every naturalist or beginner in science would commence this spring to record such facts as these, it would induce him to observe much more closely and systematically than he might otherwise.

— It may interest our botanical readers to learn that Mr. A. W. Bennett, of London, has been for some time engaged on a translation of Thomé's Lehrbuch der Botanik. It will be published in the course of the present year by Messrs. Longmans, with all the original illustrations.

PROCEEDINGS OF SOCIETIES.

Natural History Society, Montreal. — February 28th. A paper 1 the Nipigon or copper-bearing rocks of Lake Superior, with notes on)pper mining in that region, was read by Mr. J. W. Spencer.

Principal Dawson called the attention of the members present to an teresting collection of ferns and other fossil plants which had been re- ntly obtained by Mr. Albert J. Hill from near Sydney, Cape Breton, me of which were exhibited. He said that they were of interest as show- g the occurrence of forms hitherto known only in the middle and upper al formations, in beds assigned. on stratigraphical evidence, to the upper rt of the Millstone-Grit. They were also of interest from the pres- ce of at least four species of ferns showing fructification, which would ortly be described. They were further of interest as occurring in the me beds with the remains of a fossil larva of a dragon-fly, which will described by Mr. Scudder in the next number of the *Canadian Nat- alist*, and which is the first insect of that family found in the Carbon- rous rocks.

Academy of Sciences, St. Louis. — March 6th. Professor Conant, o had lately visited Southwest Missouri and examined certain curious unds there, situated some miles from New Madrid, gave a brief ac- unt of his trip. One curious discovery made was that while the skulls en from the centre of these mounds were the true mound-builder ills, two were found in the edge of one of the mounds that belonged a very different race. The exceedingly low, retreating forehead indi- ed a much lower grade of organism, yet the remains had been buried er the mound-builder fashion, with a jug on each side of the head.

March 20th. Professor Potter reported that Dr. G. I. Engelmann and self had visited the New Madrid mound region, and opened four unds, securing ten or twelve skulls and about one hundred specimens oottery.

. C. Broadhead read a paper on the Porphyritic Rocks of Southeast- Missouri, presenting evidence that these rocks are Huronian.

. J. Conant read a paper on the Mounds of New Madrid. The ial-mound examined by him was found within an inclosure of about acres, which is surrounded by earthen walls. Probably a thousand etons have been already found. Three pieces of pottery are usually id with each skeleton. Some vessels were more than a foot in neter, with walls so thin that they could not have been safely moved n filled with water. It was observed that some skeletons were in a h better state of preservation than others. In some cases the out- of the skull was shown only by a thin white line; in others the l pieces of pottery were found, but all traces of the skeleton had ppeared. Mr. Conant thought this an evidence that the mounds had been a place of burial.

Dr. Engelmann remarked that the preservation of bones depends upon humidity and the character of the soil. Many bones undoubtedly older than the bones of these mound-builders are found in a state of good preservation.

Dr. Engelmann made a communication on North American Oaks. The genus *Quercus* is more extensively developed in America than in any other part of the world. In the Carolinas, oaks grow as small shrubs. The leaves of different oaks show great variation, some resembling the leaves of the willow, others those of the holly, etc., but the fruit is very much the same in all. The typical and probably the primitive oak of the tertiary had an acorn and a lobed leaf. An oak found in California has flower and leaves like a chestnut, but bears acorns like an oak. The cup of the acorn, however, is spiny like the burr of the chestnut. Dr. Engelmann remarked that this oak may be a hybrid produced between the chestnut and the oak in bygone times when these genera were less differentiated, as it is well known that even now hybrid oaks will propagate when removed from the "struggle for existence" against more hardy rivals.

ACADEMY OF SCIENCES, New York. — March 13th. The following papers were read: Further Researches on Phosphide of Silver, by Wm. Falke; A new Test for Boracic Acid, and other Qualitative Reactions, by M. W. Iles; Comparison of the Milk of the African Race with that of the Caucasian, by Henry A. Mott, Jr.; Milk and the Lactometer, by Elwyn Waller.

Geological Section. March 20th. Mr. S. W. Ford presented an account of the discovery of additional species of fossils in the primordial rocks of Lansingburgh, N. Y., and of plant-remains in the primordial slates at Troy, and described a new species of *Microdiscus* from the latter locality, for which he has proposed the name, *M. Meeki.* He also exhibited specimens of the hitherto imperfectly known pygidium of *Conocephalites* (*Atops*) *trilineatus*, from Lansingburgh. In conclusion he made some remarks upon the probable stratigraphical horizon of the Troy beds among primordial rocks, stating that the fauna of these beds, while entirely distinct in its species from that of the Acadian or Menevian group on the one hand, and from that of the ordinary Potsdam on the other, yet shows a decided leaning, in its genera, toward the former of these groups.

The president, Prof. J. S. Newberry, gave a *résumé* of his observations on the geology of the oil regions of the United States, — all of which he had visited, — and the results of his study of the facts which seem to illustrate the genesis of petroleum.

Very briefly stated, his theory of the origin of petroleum is that it is one of the evolved products of a spontaneous decomposition of organic tissue, chiefly vegetable, which begins as soon as life ceases, and ends only with the oxidation of all the contained carbon and hydrogen. When

xposed in moist air vegetable tissue rapidly oxidizes in *decay;* when
ried under water or in earth the process is retarded, and the constitu-
ts react on each other, forming carbonic acid, carbonic oxide, water,
rburetted hydrogen, petroleum, etc., which escape, leaving peat, lignite,
al, anthracite, and graphite as residues in different stages of this pro-
essive change. Petroleum and marsh gas are constantly escaping from
considerable carbonaceous strata, and especially from bituminous shale,
ds of which underlie all our productive oil regions, and are the sources
the oil and of the gas with which it is always associated.

The carbonaceous shales of the Lower Silurian system supply the
troleum of Burkesville, Kentucky, and Collingwood and probably En-
killen, Canada. The petroleum of Western Pennsylvania is derived
m the Devonian black shales ("Cadent" of Pennsylvania, "Huron"
Ohio), which have a thickness of several hundred feet, and underlie
the oil region. When escaping from them the oil and gas rise into a
ies of overlying sandstones and conglomerates, which serve as reser-
rs, and are confined there by sheets of nearly impervious clay shale
The oil wells of West Virginia are bored in the coal measures, but in
nuch disturbed region, and the oil probably comes from the Huron
le. The oil of Mecca and Grafton, Ohio, is Lower Carboniferous. It
ound in the Berea grit, but originates in a black shale (Cleveland
le) which underlies it.

HILOSOPHICAL SOCIETY OF WASHINGTON. — March 11th. Dr.
odward continued his observations on *Frustularia Saxonica*, showing,
neans of illustrations thrown upon a screen, the misapprehensions into
ch some continental microscopists had been led by mistaking for this
ies another diatom, *Navicula rhomboides.*

Iarch 25th. Mr. Gilbert gave an account of lake formations, showing
various means by which lakes are produced, and, among others, one
h had frequently been in his opinion mistaken for glacial action.

cliffs of which the upper portion is subject to easy vertical cleavage,
e masses are frequently detached, falling into adjacent valleys, dam-
g up streams and forming lakes in this way with a mass of detritus
h had been, or was liable to be, mistaken for the material deposited
terminal moraine. These views were corroborated by Major Pow-
who mentioned several instances of such lake formations.

rofessor Mason then addressed the society on an international sys-
of archæological symbols.

CADEMY OF NATURAL SCIENCES, Philadelphia. — March 14th.
Meehan spoke of the mode of propagation of the Florida moss or
ndsia. Since he had before spoken on the subject he had had oppor-
ies of observing that where the seeds germinate they do so on the
r side of the branches, and where the bark is smooth rather than
h, thus indicating the presence of some adhesive matter on the seed.

rofessor Cope called attention to a cetacean which he had observed and described ten years ago. He had recently had an opportunity of examining an entire skeleton. It belongs to the black fish, but differs specifically from its nearest ally, and seems to be almost intermediate between the genera *Globiocephalus* and *Grampus*. The anatomical characters separating these were given, and the name *Globiocephalus brachypterus* was proposed for the species.

Professor Frazer spoke of a peculiar trap from York County. Dr. Koenig, having been engaged upon the investigation of the minerals occurring at Magnet Cove, Arkansas, gave a preliminary notice of some of his results.

Mr. B. Waterhouse Hawkins, having stated that he was at present employed in rebuilding the skeleton of Hadrosaurus in the museum, reviewed the subject of the position of the so-called clavicles, referring specially to the opinions of Professors Leidy, Huxley, and Cope. He reminded the members that in 1868, when studying the remains contained in the museum, he had adopted the opinion first advanced by Dr. Leidy, and assigned the bones in question to the pelvic arch. Professor Cope, in 1867, had published his opinion that they were pubes, but had afterwards assigned them to the position of ischia, thus indorsing the view advanced by Professor Huxley. Mr. Hawkins had already on at least one occasion demonstrated before the Academy that this opinion of Cope and Huxley was not supported by the necessities of the creature's organization, and had advanced the opinion in 1875, and previously, that the bones in question were really pubes, having the long section so placed as to support the abdominal walls, as in the crocodile and marsupials. Attention was called to the fact that corresponding bones had recently been placed by Owen in his description of Omosaurus as pubes, thus establishing the correctness of the position taken by Mr. Hawkins, with regard to them in Hadrosaurus, as far back as 1868, and steadily adhered to by him in spite of the authority of the eminent naturalists who up to the present time held a contrary opinion. Professor Cope complimented Mr. Hawkins on the results established by Owen's description of Omosaurus, and further referred to the position of the bones under consideration.

A paper was presented for publication entitled On Pachnolite and Thomsenolite, by George Augustus Koenig, M. D.

TROY SCIENTIFIC ASSOCIATION. — March 6th. Microscopical section. The fructification of Algæ was discussed, and illustrated by slides contributed by the members. Dr. J. J. Woodward's photographs of the spurious lines of *Frustulia Saxonica* were presented by Dr. R. H. Ward.

March 20th. General meeting. Rev. A. B. Hervey delivered an address on the classification of sea-weeds.

BOSTON SOCIETY OF NATURAL HISTORY. — March 1st. Mr. Alexander Agassiz remarked on the affinities of starfishes, and Dr. Hagen read a paper on The Danger from White Ants to New England.

Appalachian Mountain Club, Boston. — March 8th. Papers
ere read on the following subjects: The Atlantic System of Mountains,
Prof. C. H. Hitchcock. Illustrated by a new Model of the White
ountains. A Day on Tripyramid, by Prof. Charles E. Fay. Two
ew Forms of Mountain Barometer, by Mr. A. B. Emmons. Exhibi-
n of Mountain Profiles, by Mr. G. F. Morse.

SCIENTIFIC SERIALS.[1]

Annals and Magazine of Natural History. — February. On
r. Carter's Objections to Eozoön, by J. W. Dawson. Dr. R. Willemoes-
hm on the Development of *Lepas fascicularis* and the "Archizoëa" of
rripedia, and on the Development of some Pelagic Decapods. March.
the Polytremata (Foraminifera), especially with Reference to their
thical Hybrid Nature, by H. J. Carter. On the Budding of the
ninæ in the Stomach of the *Geryonidæ*, by B. Uljanin. Evidence of
arnivorous Reptile about the Size of a Lion, by R. Owen. On the
lations of *Artemia salina* and *Artemia Mühlhausenii*, and on the genus
anchipus by M. W. J. Schmankewitsch.

Zeitschrift für wissenschaftlich Zoölogie. — December 22,
75. On the Structure and Development of *Sycandra raphanus*, by
E. Schultze. On the Sexual Organs of *Branchipus Grubii*, by H.
sche. On the Transformation of the Mexican Axolotl into an Ambly-
ma, by A. Weismann. On the Systematic Position of *Vortex Lemani*,
L. Graff. Contribution to the Knowledge of the Bryozoa, by H.
sche. January 17, 1876. The Developmental History of *Proteus an-
neus*, by F. E. Schultze. Notes on the Developmental History of the
jadæ, by W. Flemming. On the Anatomy of Crinoids, by H. Ludwig.

etermann's geographischer Mittheilungen. — December 15,
5. The Mongols and the Land of the Tanguts. Steamer-Commu-
tion between Brazil and Columbia, by R. Reyes. On the History of
covery of the Western Coast of Australia. Stanley's Researches on
Victoria Nyanza (continuation).

syche. — February. Odoriferous Glands in Phasmidæ, by S. H.
dder.

lobus. — Nos. 6–9 contain Rebatel and Tirant's Journey in Tunis
h excellent illustrations).

he Geographical Magazine. — March. Cameron's Route from
e Tanganyika to the West Coast of Africa, by E. G. Ravenstein.
Irrigation of Firozpur, by C. R. Markham. The World's Future
1 Depot, by D. Ker. The Voyage of the Challenger, by J. G. Davis.
il. The Russian Campaign in Khokand, by A. Vambery. Peru.

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[1] The articles enumerated under this head will be for the most part selected.

by C. R. Markham. The Island of Palawan, by C. Pascoe. Easter Island Tablets.

THE GEOLOGICAL MAGAZINE. — March. Subaerial Denudation *versus* Glacial Erosion, by W. Gunn. On the Classification and Nomenclature of Rocks, by G. H. Kinahan. Sketch of the Geology of Ice and Bell Sounds, Spitzbergen, by A. E. Nordenskiöld. (Part iii.) April. A Comparison between the Oldest Fossiliferous Rocks of North Europe, by G. Linnarsson. The Probable Conditions under which the Palæozoic Rocks were deposited in the Northern Hemisphere, by H. Hicks.

QUARTERLY JOURNAL OF MICROSCOPICAL SCIENCE. — April. Observations on the Early Development of the Common Trout, by E. Klein. Recent Researches on the Nuclei of Animal and Vegetable Cells, and especially of Ova, by J. Priestley. Contributions to the History of the Germinal Vesicle, and of the first Embryonic Nucleus, by E. van Beneden. A new Process for examining the Structure of the Brain, by H. R. O. Sankey. On the Development of the Ova and Structure of the Ovary in Man and other Mammalia, by J. Foulis. On the genus *Astrorhiza* of Sandahl, lately described as *Hæckelina* by Dr. Bessels, by W. B. Carpenter.

MONTHLY MICROSCOPICAL JOURNAL. — March. Mr. Sorby's Address as President of the Royal Microscopical Society. Further Notes on *Frustulia Saxonica*, by W. J. Hickie. On Staining and Mounting Wood Sections, by M. H. Stiles. On the Characters of Spherical and Chromatic Aberration arising from Excentrical Refraction, and their Relations to Chromatic Dispersion, by Dr. Royston-Pigott.

AMERICAN JOURNAL of SCIENCE AND ARTS. — April. Review of Croll's Climate and Time, with especial Reference to the Physical Theories of Climate maintained therein, by Simon Newcomb. Principal Characters of the *Brontotheridæ*, by O. C. Marsh.

ANNALES DES SCIENCES NATURELLES. — December 31, 1875. Recherches sur les Organes génitaux mâles des Crustacés décapodes, par M. Brocchi. Nouveaux Documents sur l'Époque de Disposition de la Faune ancienne de l'Isle Rodrigue, par Alph. Milne-Edwards. De quelques Applications de l'Embryologie à la Classification méthodique des Animaux, par G. Moquin-Tandon.

THE

AMERICAN NATURALIST.

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IO AND ITS HABITS.

BY DR. JAMES LEWIS.

a mountainous region comprising adjoining portions of the tates of Virginia, North Carolina, Tennessee, and Kentucky numerous small streams which unite to form the principal s which are the head-waters of the Tennessee River. All streams, not excepting the upper portions of the Tennessee r itself, have in a greater or less degree the characters of tain torrents, which in reality they seem to be on a very d scale. The streams have very usually a rapid descent, and many places broken by shoals and rapids, the beds of the ms being usually coarse gravel or rock; there are seldom to be l stretches of placid water, and accordingly, as might well be ctured, the fauna of the region, so far at least as relates to water mollusks, is somewhat peculiar. In the gravelly por- of some of the streams abound numerous species of Unio; on nd shoals are found immense numbers of operculate univalve sks, and in the rapids, especially in rocky portions of the pal rivers, are found the beautiful and interesting shells of s of Io, which are the largest and most attractive univalves family to which they belong. The earliest account we have s group of shells may be found in the *Journal of the Academy tural Sciences*, November, 1825, in which Mr. Say described ies found in the North Fork of the Holston River in Vir- calling it *Fusus fluvialis*. From that time until quite re- , additional species have from time to time been published, them being referred to the Holston River or more vaguely ennessee." Even so late as 1873, there was only a single showing that Io had been found in any stream other than olston River. The record here alluded to occurs in the *can Journal of Conchology*, vi. 223, and bears date October

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24, 1870. If there were any persons aware of the occurrence of Io in streams other than the Holston River prior to that date, they probably had reasons for not publishing the fact. Since the date quoted, however, it has been ascertained that the distribution of Io extends to several streams in East Tennessee, rendering it quite probable that future explorations may lead to its detection in the southern part of Eastern Kentucky, and in the northern part of Western North Carolina. At the present time Io is known to occur in the following streams: North Fork of the Holston in Western Virginia; in the Holston River in East Tennessee; in the Tennessee River as far south as Bridgeport, Alabama; in the Nolachucky and French Broad rivers in Jefferson County, Tenn.; in the Clinch River at Black's Ford, Anderson County, Tenn., and at Williams' Ford in Roane County, Tenn.; and in Powell's River at Kraushorn's Ferry, near the State of Kentucky.

Observers who have made any records of the habits of Io agree in stating that the shells are found only in swift water, though there appear to be discrepancies as to the abundance of specimens, which may indicate that some localities are more favorable for them than others. It must be inferred that Io, living in streams the currents of which are very rapid, is specially organized, and adapted to the situations in which it is found. Such, indeed, seems really to be the case; for a lady who collected specimens in some of the rivers of Tennessee wrote of them as follows: "The muscular power of Io is astonishing. I frequently find one adhering to a rock half as large as my head, and when I take up the shell it brings the rock with it, and requires much force to separate it." [1]

It is somewhat strange that shells of so much beauty as some of the species of Io display are scarcely known to the inhabitants dwelling in the neighborhood of the streams in which they occur; yet it seems, from records made of the contents of ancient burial places, that they were known to the people who inhabited the country prior to the advent of European races. Mr. Lea, writing upon this subject,[2] makes the following suggestive remark, which conveys a great deal in a few words: "Professor Troost informs me they [Ios] are rare in the river [Holston]; that they had been observed in the graves of the aborigines; and as it was generally believed that these were 'conch shells,' consequently coming from the sea, it was urged that the inhabitants who possessed

[1] American Journal of Conchology, vi. 223.

[2] Observations, etc., i. 224.

n must have come over the sea. It does not appear that [Ios] had been observed in their native element, though liv- at the very doors of the persons who had remarked them in tumuli." The impression that Io is a "sea-shell" is one that tes most ordinary observers at first sight, as every collector has them can testify.

uite a considerable number of species of Io may be found ribed and figured in various works treating on the shells of th America, and there is considerable diversity exhibited in forms, sizes, colors, and markings. There seems to be con- able difference of opinion among persons who have studied shells, as regards the number of species. There are some iduals who with apparent good reason believe that there is y only one species of typical Io, to which all the forms are rdinate as varieties; while on the other hand we shall find s who for reasons quite as good insist that there are five or "good species." The shells, taken by themselves, without d to any facts relating to their habits, do not afford conclu- estimony as to species, as it is exceedingly difficult to isolate that cannot be made part of a continuous series when large ers of shells are placed together. There are, however, some connected with geographical distribution and the association ried forms, which seem to indicate conclusively that there ertainly two species; and, this being admitted, the logical nce might be, under all the circumstances which remain un- ered, that there are more than two species. This, however, estion which remains to be investigated. The facts upon two species are inferred are the following. At Black's Clinch River, Anderson County, Tenn., two forms of Io con- very nearly all that are found at that particular locality, hese two forms occur there in about equal numbers, and re not associated with them any intermediate forms uniting tremes. Thirty or forty miles down the river (following ding course), at Williams' Ford in Roane County, these wo forms reappear, but their relative numbers have changed. s point the form which seems to be identical with a shell by Reeve as *Io turrita* (not Mr. Anthony's species of that by any means) is the shell occurring in fewest numbers, he prevailing form is a graceful, slender variety of the shell r. Lea calls *spinosa*. The change in the relative abundance forms by a change of station seems to afford evidence rela- species. In following out the train of ideas which this suggests, it is perhaps appropriate in this connection to glance at the subject of geographical distribution as it relates to other forms, and suggest some of the conditions that seem to be correlated to the diverse forms. A little reflection will satisfy the most casual observer that the conditions under which Io is found are subject to variations of no small magnitude. First to be considered is the climatic condition, affected by the combined influences of latitude and elevation, conspiring in the northern limit of the region inhabited by Io to produce a lower mean annual temperature than may be inferred at the southern limit. There may be in all a difference of four or five degrees of latitude, and possibly from two hundred to four hundred feet difference in elevation. In the northern portion of the area inhabited by Io are found those forms destitute of spines, associated with others in which the spines are only rudimentary or reduced to mere tubercles. To the southward, the smooth forms diminish in numbers, and disappear entirely before the central latitude of Tennessee is reached, and as a warmer climate is approached the development of the spines becomes more and more luxuriant. This is true of the Holston River in Virginia and Tennessee, and recent observations have detected a similar state of facts in the Clinch River and its tributary, Powell's River. Besides the influences of climate dependent on latitude and elevation, it may be conjectured that there are other influences affecting Io, some of them in a considerable degree depending on the mineral properties of the water due to the variable qualities of rock and soil among the mountains of that region. In evidence of this may be suggested the differences in size and appearance of shells from different streams.

In correlating these differences we shall find the most robust Ios in the Holston River. The roughest shells, as regards the whole surface, occur in French Broad River. The most slender and graceful forms are found in Clinch River. The smallest adult forms occur in Powell's River, where there are also other peculiarities observable that contrast curiously with what is known of Io elsewhere. The tubercular and spinous forms of Powell's River exhibit their characteristics (spines and tubercles) in a more rudimentary form than those found else where, and on averaging the specimens it will be observed that they appear to have one whorl less, and more spines or tubercles on each whorl, than is observable in the more luxuriant forms of other localities. How much of all the differences in forms here suggested is ascribable to species

ot at this time a subject of inquiry. In color, the shells of
nch Broad River are remarkable for green tints in the epi-
mis. In the Holston River the tints are somewhat ferruginous,
not to the same extent observable in the shells of Powell's
er; while in Clinch River the epidermis is often of a bright
ow or orange, varied by livid tints which are partaken of by
y other univalve mollusks inhabiting that stream.

he reader may possibly have felt, in reading a portion of this
er, some curiosity to know why Io occurs only in the upper
ers of the Tennessee system of drainage. In the introductory
graph of this paper it was stated that "all these streams, not
pting the upper portions of the Tennessee River itself, have
greater or less degree the characters of mountain torrents,
h in reality they seem to be on a very grand scale." From
t we now know of Io we may infer that it cannot exist in
d rivers, and the limit of its distribution south in the Tennes-
River depends on the character of the river. At the point
e the Tennessee begins to be a majestic, placid stream, there
ases to extend its domain. This very simple inference is a
to the solution of other problems relating to the geographical
ibution of allied forms in the same great family of mollusks.
many of the univalve mollusks of the Tennessee drainage
nd in swift shoal water, among rocks over which the water
in broken torrents, and nowhere among still waters. The
essee River at Mussel Shoals is very prolific in various
of mollusk life which delight in a rapid current; but below
point, in the navigable portions of the stream, very many of
interesting species disappear, because the conditions are no
r favorable to their existence.

us far, in the main, only the typical Io has been considered.
is another group of shells very nearly allied to Io, known
generic designation *Angitrema.* Mr. Reeve regarded these
as properly belonging in the genus Io; but his views do not
to have met with much favor by writers on American
ology on this side of the Atlantic. Notwithstanding this
t difference in opinion, there is much reason for believing
Ir. Reeve's position is a good one, for some of the species of
rema are apparently related to Elk River, the Cumberland
, and some of its tributaries, as Io is to the head-waters of
nnessee River. Indeed, it appears to be true that near the
where Io begins to disappear in the Tennessee River in
ma, some of the forms of Angitrema replace it. The ques-

tion of the relative geographical distribution of Io and Angitrema, taken in connection with obvious resemblances in the shells detected by Mr. Reeve, seem to favor the suggestion that Angitrema is but a minor phase of Io. In habits the animals, so far as is known, are somewhat similar to each other, with this difference, that Angitrema is fitted to dwell in more quiet waters than the necessities of Io require.

Taken in another aspect, the inquiry why Io should be confined apparently to the head-waters of the Tennessee River can be answered (in the proverbial Yankee style) by offsetting the inquiry why a curious group of shells with a fissured lip should be found only in the Coosa River in Alabama. This, like much more that might be made the subject of inquiry, is a part of the unwritten history of Io that remains to be investigated.

The reader who may desire to refer to a summary of what has been written on species of Io will find such information as is available for the purposes of a naturalist in a work entitled Strepomatidæ, by G. W. Tryon, Jr., Smithsonian Miscellaneous Collections, No. 253.

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A POPULAR EXPLANATION (FOR THOSE WHO UNDERSTAND BOTANY) OF THE MATHEMATICAL NATURE OF PHYLLOTAXIS.

BY THE LATE CHAUNCY WRIGHT.[1]

TAKE, by the finger and thumb of your right hand, hold of a spike of *Plantago major*, *Lepidium Virginicum*, or other flower-cluster with symmetrically crowded flowers, and with the finger and thumb of the left hand grasp it a little higher up, so as to include between the two hands a dozen or twenty buds on a piece of stem about equally tough from end to end. Twist the stem, and if it twists equally in all parts you will bring your buds into a small number of ranks, let us say 8. By twisting a little in the opposite direction you will get them into 5 ranks. Twist harder, and if your stem is tough enough to stand the twist you will bring them into two ranks. Turn back to 8 rows, and twist harder in that direction ; you will fetch your buds into 3 rows. Then twist still harder in that direction, and if you have an old, tough, plaintain spike, you may get the seed-vessels all into one row before your stalk is twisted off.

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[1] This article was prepared by Mr. Wright several years ago, at Professor Gray's suggestion. In its manuscript form it has been found of much interest and value to the botanical students in Harvard College. It is here reprinted without change from Mr. Wright's notes.

Thus by mechanical twisting, if the twist is equal in all parts the stem, we get on one side of the natural position the num- r of rows 5 and 2, and on the other side 8, 3, and 1. Hence if begin with the most twisted position and come toward the tural position, we get the numbers

On one side 2 5

On the other . . . 1 3 8

Now these series of numbers indicate the approach towards the twisted position. What would be the number of ranks in that oretically perfect untwisted state? As both these series of mbers are increasing, that is, the number of ranks decreases as u twist either way, you may infer that in the untwisted state number of ranks is prodigious or innumerable. Carrying on series by adding zigzag as the lines are dotted, we should

2 5 13 34 89 233

1 3 8 21 55 144 377

Hence we say that the slightest conceivable twist in one direc- makes the number of ranks 377; a little more in that direc- gives 144, 55, 21, 8, 3, 1, while the slightest twist in the op- ite direction gives us 233, a little more 89, 34, 13, 5, 2, 1.

There is, however, a mystery in the space between 233 and , between twisting one way and twisting the other. Let us seek to solve it by running the number of ranks up higher, to , 987, 1597, etc., but approach it in another way.

n the stem twisted one way, the angle between the leaves is e whole circumference, or $\frac{2}{5}$, or $\frac{5}{13}$, or $\frac{13}{34}$, etc.; with the stem sted the other way the angle is $\frac{1}{3}$, or $\frac{3}{8}$, or $\frac{8}{21}$, or $\frac{21}{55}$ etc., the umference. Let us set these in double rows: —

Twisted one way . . .	$\frac{1}{2}$	$\frac{2}{5}$	$\frac{5}{13}$	$\frac{13}{34}$	$\frac{34}{89}$	$\frac{89}{233}$.
Twisted the other way . .	$\frac{1}{3}$	$\frac{3}{8}$	$\frac{8}{21}$	$\frac{21}{55}$	$\frac{55}{144}$	$\frac{144}{377}$.

r putting them in decimals we shall see how they converge ards the same value: —

Twisted one way . .	.5	.4	.38	.382	.38202
Twisted the other way .	.33	.375	.3809	.3818	.38194

ake the high fraction $\frac{1597}{4181}$ in the upper series and turn it decimals, we get .38196603. If the leaves were at this angle would form 4181 rows or ranks, and the least twist would luce the lower numbers. Let us now attempt to find some simpler mode of representing these fractions .38196608 or $\frac{1597}{4181}$, which are the same.

Dividing both numerator and denominator of $\frac{1597}{4181}$ by 1597 will give $\cfrac{1}{2+\cfrac{987}{1597}}$; dividing each term of the last fraction by 987 gives us

$$\cfrac{1}{2+\cfrac{1}{1+\cfrac{610}{987}}}$$

and continuing the process gives us

$$\cfrac{1}{2+\cfrac{1}{1+\cfrac{1}{1+\cfrac{377}{610}}}}$$

equal to

$$\cfrac{1}{2+\cfrac{1}{1+\cfrac{1}{1+\cfrac{1}{1+\cfrac{233}{377}}}}}$$

equal to

$$\cfrac{1}{2+\cfrac{1}{1+\cfrac{1}{1+\cfrac{1}{1+\cfrac{1}{1+\cfrac{144}{233}}}}}}$$

equal to

$$\cfrac{1}{2+\cfrac{1}{1+\cfrac{1}{1+\cfrac{1}{1+\cfrac{1}{1+\cfrac{1}{1+\cfrac{1}{1+\cfrac{1}{1+\cfrac{1}{1+\cfrac{1}{1+\cfrac{1}{1+{}}}}}}}}}}}\ \text{etc.}$$

Now calling the fraction

$$\cfrac{1}{1+\cfrac{1}{1+\cfrac{1}{1}}}$$

continued indefinitely by the name of x, it is plain that the phyllotactic fractions beginning with $\frac{1}{2}$, $\frac{1}{3}$, $\frac{2}{5}$, $\frac{3}{8}$, $\frac{5}{13}$ continually approach nearer and nearer to the value $\frac{1}{2+x}$, or

$$\cfrac{1}{2+\cfrac{1}{1+x}}$$

or

$$\cfrac{1}{2+\cfrac{1}{1+\cfrac{1}{1+x}}}$$

and these values are alike. Putting the first two equal gives

$$\frac{1}{2+x}=\cfrac{1}{2+\cfrac{1}{1+x}}$$

whence

$$x^2+x=1,\ x=-\tfrac{1}{2}+\tfrac{1}{2}\sqrt{5},\ \text{and}\ \frac{1}{2+x}=\tfrac{1}{2}\,(3-\sqrt{5}).$$

This expression, $\frac{1}{2}\,(3-\sqrt{5})$, is equal to .38196+, and expresses the exact ratio of the leaves in a theoretically untwisted stem when the number of rows is infinite. Other arrangements ıre simply approximations to this (as though they aimed at this ›ut got the stem twisted in growing), such as

$$\cfrac{1}{1+\cfrac{1}{1}}=\frac{1}{2} \qquad \cfrac{1}{2+\cfrac{1}{1}}=\frac{1}{3}$$

$$\cfrac{1}{2+\cfrac{1}{1+\cfrac{1}{1}}}=\frac{2}{5} \qquad \cfrac{1}{2+\cfrac{1}{1+\cfrac{1}{1+\cfrac{1}{1}}}}=\frac{3}{8}$$

TRACES OF AN AMERICAN AUTOCHTHON.

BY DR. C. C. ABBOTT.

WHEN in our rambles over the fields, in search of relics, we chance to find lying side by side some rough, rude imple-ıent and a delicate, artistically-wrought arrow-point, we are apt merely glance at the former, and perhaps smile at so poor an fort at flint-chipping, while admiring the beauty of finish and cellence of workmanship displayed by the latter. But the ıshapely implement has a history that, if not as eloquent as the gends of the red man, is far older, and calls up a shadowy vis-n of a still more distant time, when another people dwelt in is goodly land, and fashioned for its use these rude stone weap-s that now alone are left to tell its story, and recall the time ıen this "great continent was occupied by a wide-spread ough sparse population."

During the summer of 1872, having heard of the occurrence Indian relics in a gravel bank then being removed, I carefully amined the face of the bluff, and succeeded in finding a single ne implement, and subsequently two others. These three ecimens were described and figured soon after,[1] and I then ex-essed the opinion that, "had but a single specimen been found, might reasonably, perhaps, have applied to it the doctrine of ınces, and maintained that it was merely a freak of nature; t the occurrence of three specimens so near each other effect-lly disposes of the justice of such an opinion, and we must nit the antiquity of American man to be greater than the ent of the so-called Indian."

have lately succeeded in finding a few specimens of relics, in ıta of river drift, similar to those figured in the NATURALIST, higher up in the series; thus apparently connecting them h the rude forms found near and occasionally on the surface, ich I formerly believed to be the forerunners of the later relics. The intermediate specimens above referred to, seven in number, are rudely wrought lance-heads (?) and those ridge-backed, flat-bottomed implements, known locally as "turtle-backs." The supposed lance-heads are very similar to the European palæolithic forms, and in all respects identical with those found nearer the surface, of which the late Professor J. Wyman said,[1] in a notice of a series sent him, "There are several implements which very closely resemble the celts of the drift period of Europe, especially those found at St. Acheul, two or three of which, except for their material, could hardly be distinguished from them."

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[1] The American Naturalist, vii. 204.

My studies of these palæolithic specimens, and of their position in the gravel beds and overlying soil, has led me to conclude that not long after the close of the last glacial epoch man appeared in the valley of the Delaware, and that during his occupancy there was a steady but not violent physical change of the general surface of the country, caused by the greatly increased volume of the river then nearly filling the present valley; and that at a point in time when the river (Delaware), diminished to its present size, occupied its present channel, these palæolithic people were driven off by the Indians, who at that time were themselves not advanced to the neolithic or polished-stone age condition. On examining a series of stone implements gathered from some one spot, we find one characteristic, common to all, which at once attracts the attention. This is the uniformity of the workmanship. As remarked by Professor Geikie, "The weapons and implements belonging to the older or palæolithic period are altogether of ruder form and finish. They are merely chipped into the requisite shape of adze, hatchet, scraper, or whatever the implement may chance to be. Although considerable dexterity is shown in the fashioning of these rude implements, yet they certainly evince much less skill on the part of the toolmaker than the relics of the newer or neolithic period. It is somewhat noteworthy also that while the implements of the neolithic period are made of various kinds of stones, those of the palæolithic period consist almost exclusively of *flint;* and so characteristic are the shape and fashion of the latter that an experienced archæologist has no difficulty in recognizing and distinguishing them at once from relics of the neolithic age."[2]

With the exception of the use of the word "flint," the above is in every way applicable to the rude implements here considered to be the production of an older people than the Indians.

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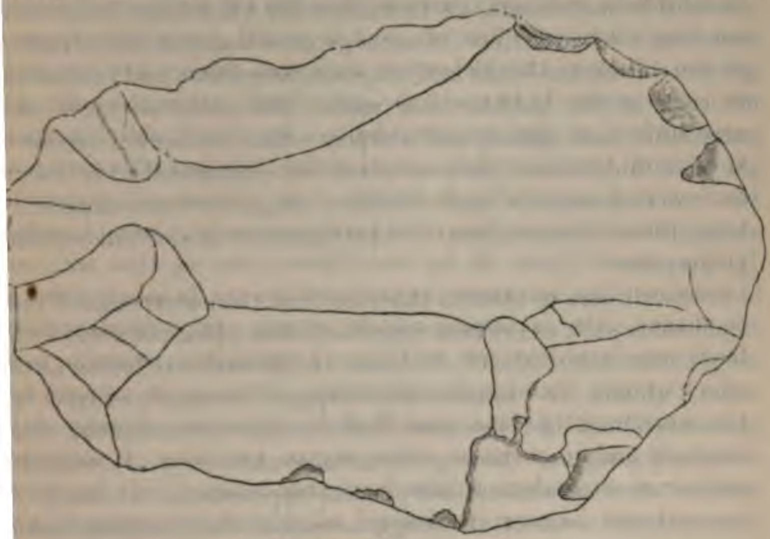
[1] Fifth Annual Report of the Peabody Museum of Archæology, page 27. Cambridge. 1872.

[2] Great Ice Age, American Edition, page 404.

Again, on examination of a large series of these relics, considered with reference to the circumstances under which they were gathered, it is found that the mineral of which they are almost exclusively made is not really a soft stone, easily worked; nor on the other hand as dense as jasper or quartz. A freshly fractured urface will readily scratch glass. Their surfaces are, however, quite soft, from long exposure since their detachment from the parent rock. In fragments of a rock buried in ordinary soil, and not exposed to unusual chemical action, any decomposition, if it ook place at all, must have been very gradual; indeed, inconceiv-



(Fig. 21.) "TURTLE-BACK" CELT.

ly slow; and it seems more probable that these implements ere long exposed to the weather on or near the surface of the ound, before the slowly increasing deposit of soil or stratum of nd or gravel, as the case may be, concealed them from view. his "weathering" of the surface of rude implements varies conderably in depth, but is not more noticeable on any one pattern the few forms common to these older relics. It occurs on all, d the variation, ranging from $\frac{1}{32}$ to $\frac{1}{128}$ of an inch, indicates, I lieve, a greater antiquity of the more deeply corroded speciens. A peculiarity which also tends to separate these rude lics from the more common or true Indian relics is the prevaice of certain forms of a marked character, which do not occur of jasper, quartz, or other minerals used by the Indians. The most marked of these forms is that here figured, which I call, adopting the local name, a "turtle-back." The name quite accurately describes this peculiar form of stone implement. It is only necessary to say that they are flat upon the under side, usually presenting but one surface; and where two or three, the lines of separation are scarcely definable, and the specimen, when placed upon a level surface, appears to be perfectly smooth underneath. They vary but little in size, the one here figured (Figure 21) being an excellent example of an average specimen of this form of stone implement.

Considering this turtle-back as the primitive form of these palæolithic implements, we find that they vary from it, in three directions: towards the common grooved ax, but never with a groove; into spear-heads and large arrow-points; and into scrapers, such as the Indians later used. But while we meet with palæolithic axes, spears, and scrapers which are quite similar to the neolithic forms, they can never be confounded with them; the workmanship is quite distinct, and, however unusual its shape, there is that about it that marks it as *not* an ordinary Indian relic.

It is well here to refer to the fact that the occurrence of rude implements such as are here described takes place not only in this neighborhood, but Mr. C. C. Jones, in his work on Indian antiquities,[1] alludes to "some rudely-chipped, triangular-shaped implements found in Nacoochee Valley under circumstances which seemingly assign to them a very remote antiquity. In material, manner of construction, and general appearance, so nearly do they resemble some of the rough so-called flint hatchets belonging to the drift type, as described by M. Boucher de Perthes, that they might very readily be mistaken the one for the other. . . . . At a depth of nine feet below the surface, intermingled with the gravel and bowlders of the drift and just above the rocky substratum upon which the deposit rested, were found three flint implements. . . . . That the implements in question were brought down with and deposited in the drift when as yet there was little or no vegetable life in the valley, seems highly probable. How many centuries have looked down upon the gradual accumulation of the soil which now overlies the drift, none can answer; but of one thing we may rest satisfied, that these specimens of the rude labor of prehistoric man may well claim high antiquity. . . . . Thus, in Nacoochee, while the neolithic age is richly represented, the palæolithic period is not entirely wanting in its characteristic types."

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[1] Antiquities of Southern Indians, page 294.

The above well describes what obtains in the valley of the Delaware, except that the palæolithic period is quite well represented, and without so abrupt a break between that and the neolithic age.

Having, I trust, made the reader sufficiently familiar with the nore prominent characteristics of these rude implements, as ompared with the common forms of Indian relics, I propose ow to determine, if possible, something concerning their origin; nd to suggest to what race these palæolithic folk belonged.

If it is true that the relics of preoccupying races, now scattered ver the State, are traces of two distinct peoples, it is obvious hat either the older occupants of the territory passed away be-ore the advent of the Indian, or they were driven from the ountry by the latter race. Had the palæolithic folk disappeared rom the valley of the Delaware at some time long prior to the dvent of the Indian, there would have been a break in the eries of stone implements now found, and no commingling what-ver, for a people once established would totally disappear only n consequence of geological changes occurring; and such would ufficiently alter the surface of the country to embed the relics n strata at some distance beneath the soil. Marked changes in he contour of the territory here considered have certainly taken lace since the first appearance of man in eastern North America, ut these changes have been so gentle as not to destroy the habit-bility of the country, and we therefore find the traces of that arlier people not only in the underlying gravels, but in the soil bove, proving, I think, that palæolithic man did not disappear at point in time anterior to the Indian's first appearance. It ust be remembered, too, that the Indians claim to have been a surping people; to have found, on their arrival, a preoccupy-g people, whom they dispossessed of their lands. If such is e case, — and do not the deeply buried rude relics here described thenticate their statements? — then two questions naturally rise in one's mind: Who were these ancient people? Where re they now?

It is scarcely probable that a race driven from their homes in e valley of the Delaware should have entirely left the country. hey could not have crossed the ocean; and we look at the ighboring peoples to find the descendants of this displaced people, if indeed they have not perished from off the face of the earth.

Have we near at hand any people that even in some respects meet the requirements of our supposition? I believe we have, in the Eskimo.[1]

The similarity of the Delaware Valley implements to those of Europe, as already referred to, is even more marked when the former are compared with the relics from French caves. The stone implements figured by Lartet and Christy,[2] illustrative of the weapons, domestic utensils, and ornaments of the reindeer people of Southern France, are, in part, so exactly reproduced in the palæolithic relics of New Jersey, that a close relationship of the two peoples suggests itself; although no caves such as are found in France, or engravings of extinct mammalia, have been discovered here.

In the brief space allotted to a magazine article, it is not practicable to enter minutely into detail with reference to the many facts having direct bearing on the question of the gravel-bed implements, their antiquity and origin. I have but briefly referred to the marked resemblance between New Jersey and French cave specimens of stone relics, and will here only add that "it would be easy to cite many circumstances illustrative of the resemblance between the condition and habits of the modern Eskimo and these cave dwellers of France at the reindeer period."[3] If, therefore, the rude implements of the Delaware Valley gravels resemble those of the caves of France, and the French troglodytes were identical (?) with the Eskimo, it is fair to presume that the first human beings that dwelt along the shores of the Delaware were really the same people as the present inhabitants of Arctic America.

It has been demonstrated, I believe, conclusively, that some eighty thousand years ago the last glacial epoch came to a close.[4] There was, however, no sudden change in the climate. The vinters were more severe than now, the summers shorter, and he reindeer still abundant. At this time, the river, now occupyng a comparatively small and shallow channel, flowed at an eleation of nearly fifty feet above its present level; and it was vhen such a mighty stream as this, that man first gazed upon its vaters and lost those rude weapons in its swift current that now, n the beds of gravel which its floods have deposited, are alike the uzzle and delight of the archæologist. Had these first comers, ike the troglodytes of France, had convenient caves to shelter hem, doubtless we would have their better wrought implements f bone to tell more surely the story of their ancient sojourn ere; but, wanting them, their history is not altogether lost, and n the rude weapons, now deep down beneath the grassy sod and ower-decked river bank, we learn at least the fact of the presnce, in the distant past, of an earlier people than the Indian, nd have a veritable trace of the American autochthon.

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[1] Since the above was written, I have received Nature for December 9, 1875, and find the statement there made, in a review of Dr. Rinks's Tales and Traditions of the Eskimo, that that author "is strongly of opinion that the Eskimo are an indigenous American people, who have been pushed northwards by the intrusive Indian tribes." This opinion of Dr. Rinks's, it will be noticed, if correct, is confirmatory of that taken in this paper, and in the February number of this journal, as to the traces of successive occupation of this country by two peoples, as indicated by the relics now found here.

[2] Reliquiæ Aquitanicæ. London. 1865–74. Edited by T. Rupert Jones.

[3] Reliquiæ Aquitanicæ, page 26.

[4] Climate and Time, by Croll; Great Ice Age, by J. Geikie.

JOHNNY DARTERS.

BY D. S. JORDAN AND H. E. COPELAND.

ANY one who has ever been a boy, and can remember the days of green meadows, tag alders, and an angleworm on a pin ook, surely has not forgotten the little dusky fish which lay erfectly motionless on the pebbly bottom of the shallow stream, ntempted by fly or worm, while over his head the silly little innows strained their toothless mouths in a vain endeavor to vallow the bait meant for the nobler sun-fish. You will rememer, too, that when, after watching him a while, you put down our hand to catch the little philosopher, just as you had coved him and were sure you had him he was resting as comosedly as ever a few feet farther up the stream. That little sh was a Johnny Darter.

It is an ancient and venerable family, that to which he bengs, the family of Darters. It is exclusively American, but one the less ancient and venerable on that account, for its memrs in every pond and brook of our Eastern United States trace ck their lineage through a dozen lines of descent to a primitive rter, which lived and loved a million of years before the time David Bruce or William the Conqueror.

The naturalists know them as *Etheostomoids*, from *Etheostoma*, e name given by Rafinesque to the first ones described, for until 1820, no writer on such matters supposed the Johnnies to be fully developed fishes, but thought them the young of some perch or bass. Even for twenty-five years later, the wise men of the East who study nature in books and bottles, and do not know her when they meet her out-of-doors, spoke of Etheostoma as a mere "myth," having "no existence save in the fertile brain of men of versatile but disordered intellect," as they were pleased to style Rafinesque and others who saw things not described by Cuvier or dreamed of by Valenciennes.

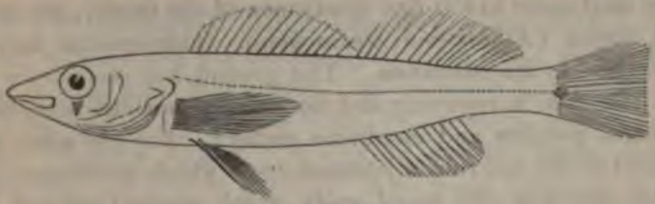
The books call these fishes "Darters," from *Boleosoma* (*dart body*, in Greek), the name of the common eastern species; the realistic dwellers of the Ohio Valley call some of them hog-fishes; the boys call them Johnnies, and, as the boy instinct is the truest, Johnny Darters they shall be.

All the darters are very small fishes; the largest barely reaches the minimum of size on the urchin's string when he comes back from the mill-pond, while the smallest is with one or two exceptions the least of all fishes. They have only the rudiment of an air bladder, and are therefore unable to float freely in the water or even to swim at all without severe manual — not caudal — labor. They rest quietly on the bottom for the most part, curled up under a stone or standing on their front and tail fins; now and then throwing themselves forward for a short distance by a broad and sudden sweep of the pectorals, to snap at some water-bug or to dodge the claws of some crawfish or the grasp of some small boy. This movement made, they come to rest, either permanently or until they can bring their arms forward again. When a darter wishes to swim for any distance his course is peculiar: at every impulse forward he rises in the water; at every rest he begins to fall, his face meanwhile wearing an expression of contented helplessness. The whole movement is much like that of a boy learning to swim, whose nose goes under when he brings his arms forward after each stroke.

The mouth of the darter bristles with teeth, which indicate its carnivorous habits, and its great voracity makes it in a small way the terror of the aquarium, for it carries death and dismay to timid water-snails and the smaller crustaceans. It pounces upon a piece of meat with all the ferocity of a wild-cat, having none of the timid eagerness characterizing the minnows, and little of the graceful dash of the perch and bass.

Rafinesque says of the Johnnies of his acquaintance, "They are good to eat, fried." This is doubtless true, but I should as on think of filling my pan with wood-warblers. The good man es a-fishing not for "pot-luck," but to let escape "the Indian ithin him."

Their small size, brilliant coloration, quaintness, and hardiness nder the darters very desirable aquarium fishes, much more tractive in every respect than the cheap and vulgar gold-fish. ney are little known even to naturalists; few of them have er been figured, and the biography of none ever written, so we pe that this attempt to tell the story of some that we know may t be unattractive to those who can see something more in a tle fish than a possible dinner to themselves or to a king-fisher.



(FIG. 22.) PERCINA.

The barred darter or log perch (*Percina caprodes;* Figure 22 resents a species of Percina) is the largest of the Etheosto- ids. It may be most readily known by its superior size and its peculiar pattern of coloration. The ground color is pale e, darker above, silvery beneath; on this are about fifteen k vertical bars or incomplete rings, alternating more or less fectly with as many shorter ones, which reach only half-way n or to the lateral line; the hindmost bar is reduced to a e spot at the base of the caudal, and there are many black ks and mottlings on the fins. The body is long and slender, rly cylindrical, and firm and wiry to the touch; the dorsal are large, and the first consists of about thirteen spines; the l is flat on top and tapers into a flat, pointed snout, which bruptly squared off at the end, much overlapping the small ith, after the fashion of the pig. The lateral line, as in all species mentioned in this article, is perfectly distinct from the l to the tail.

ercina reaches a length of six or eight inches, and it may be lily caught with a hook baited with a worm. I often meet rchin with one or two of them strung through the gills on a ed stick, along with "red eyes," "stone toters," and other ys' fish." At such times, I generally buy the log perch for nt, cut it open to look at the air bladder which the books say it does not have, and then lay it away with the rest of my treasures in the bottle of alcohol.

We find Percina usually in rapid and rather deep water, as deep as we dare wade in when seining in hip boots. We rarely find them small enough for ordinary aquarium purposes, and the living specimen before me, though wonderfully quick and graceful, has shown little that is noteworthy, save his courage, love of angleworms, and a possible disposition to bury himself in the sand. There is something in the expression of his face, as he rests on his "hands and feet" on a stone, remarkably lizard-like, reminding me of the blue-tailed skink (*Eumeces fasciatus*).

We next come to the fine gentleman of the family, the black-sided darter (*Etheostoma blennioides*). This species may be known best by its coloration. The ground hue is a salmon yellow; the back is regularly and beautifully marbled with black, forming a peculiar and handsome pattern. On the sides, from the head to the tail runs a jet-black band which is widened at irregular intervals into round spots, which contrast sharply with the silvery color of the belly. Or we might say that on each side is a chain of confluent, round, black blotches. At times these spots are quite pale and do not seem to meet, but in an instant they regain their original form and shade. These changes are when the fish is excited by the presence of things eatable. A male in our aquarium underwent almost in an instant an entire change of pattern upon the introduction of a female fish of the same species, whom he recognized as his true affinity. Although the two have been together for some weeks, the novelty has not yet worn off, and though his colors vary much from one hour to another, he has never quite reverted to his original dress.

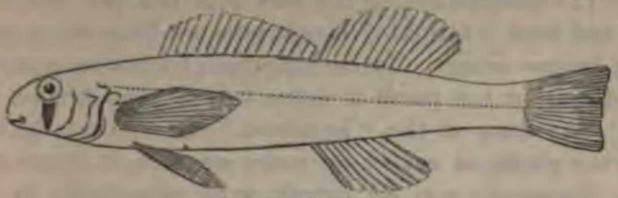
The form of the black-sided darter is more graceful than that of any other, and his movements have less of the angular jerkiness which distinguishes his relatives.

The dorsal fins, as in Percina, are long and large, the number of spines being about fourteen. Etheostoma delights in clear running water, and he may be found in most streams south and west of New York. A notable peculiarity is the presence of a row of shields or enlarged scales along the middle line of the belly. These may serve to protect that part from the friction of the stony bottom. They seem to be shed at some seasons, but when and why is unknown.

Etheostoma is especially desirable for aquaria. He is hardier than any other fish as pretty, and prettier than any other as

ardy, and withal he "has a way of his own," as Barney Mullins
aid of Thoreau.

The most simply beautiful of all fresh-water fishes is the green-
ded darter (*Diplesium blennioides;* Figure 23 represents a



(Fig. 22.) DIPLESIUM.

ecies of this genus). He is not, like the Pœcilichthys, an ani-
ated rainbow, but has the beauty of green grass, wild violets, or
log covered with green moss. As we watch him in the water,
ith his bright, blended colors and gentle ways, once more, with
aak Walton's Angler, "We sit on cowslip banks, hear the
rds sing, and possess ourselves in as much quietness as the si-
nt, silver streams which we see glide so quietly by us."

During the ordinary business of the year the Diplesium, like
ost sensible fishes and men, dresses plainly. It is a serious
atter to get any time for contemplation when the streams are
w and food scarce, and a plain coat may ward off danger as
ll as facilitate attack. At all times, however, he may be known
these marks: the fins are all large, and the first dorsal has
irteen spines; the back is covered with zigzag markings down
the lateral line, which is complete and continuous, while be-
w it extend eight or nine arrow-shaped, olive spots, which are
ore or less connected above, sometimes as if forming a wavy
e; these are on a nearly white ground, which blends with the
iform coloration of the belly. The eyes are quite large and
ominent, the snout is short and rounded, giving a decidedly
g-like profile, while on a front view the little, inferior mouth
ems puckered with "prunes and prisms." The roof of the
uth is toothless, though all the other Johnnies have small
th on the front part of the roof behind the jaws, the region
hnically known as the vomer.

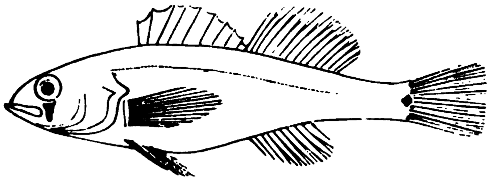
But when the first bluebirds give warning by their shivering
d bodiless notes that spring is coming, then the Diplesium
ts on his wedding clothes and becomes in fact the green-sided
rter. The dorsal fins become bright grass-green, with a scarlet
nd at the base; the broad anal has a tinge of the deepest em-
ld, while every spot and line upon the side has turned from

an undefined olive to a deep, rich green, scarcely found elsewhere in the animal world except on the backs of frogs.

The same tint flashes out on the branching rays of the caudal fin, and may be faintly seen struggling through the white on the belly. The blotches nearest the middle of the back become jet-black, and thickly sprinkled everywhere are little shiny spots of a clear, bronze orange. In the aquarium, Diplesium seems more shy and retiring, too much of a fine lady to scramble for angle-worms or to snap at the "bass-feed." She is usually hidden among the plants, or curled up under an arch of stones or in a geode. Specimens may be caught most abundantly in rapid, gravelly streams, but we often find stray individuals lying on sandy bottoms, the proper home of the Pleurolepis.

Boleosoma effulgens[1] is the darter of darters. Although our earliest aquarium friend, for the very first specimen placed there showed us by a rapid ascent of the river-weed how "a Johnny could climb trees," he has still many resources which we have never learned. Whenever we try to catch one with the hand we begin with all the uncertainty which characterized our first attempt, even if we have him in a two-quart pail.

He may be known from his cousins by his short first dorsal fin of nine spines, and by the absence of all color save soft brown on white that has the faintest tinge of yellow, but not a dirty white at all. The other nine-spined darters, Pœcilichthys, etc. (Figure 24 represents a species of this genus), have a different mouth, a projecting lower jaw,[2] the body deeper, and the lateral line vanishing on the back of the body. The brown on the sides of Boleosoma is arranged in seven or eight W-shaped marks, below which are a few flecks of the same color. Covering the sides above the lateral line are wavy markings, — gathered into blotches on the


(FIG. 24.) PŒCILICHTHYS.

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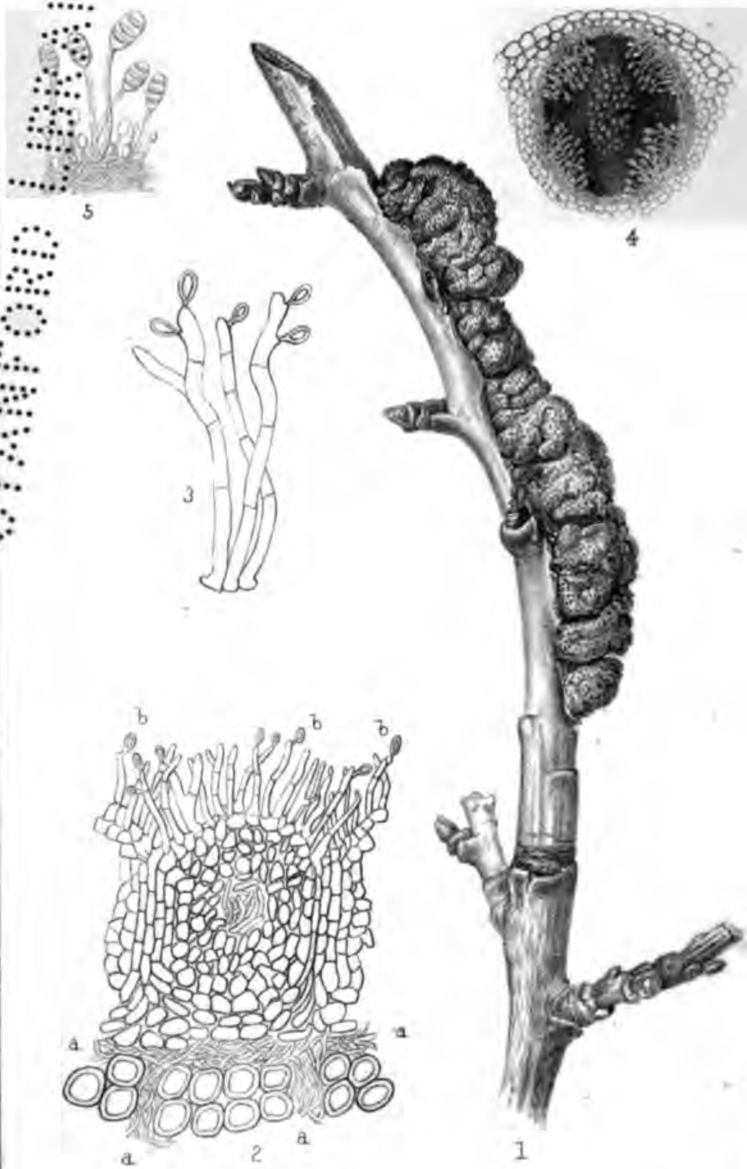
[1] *Boleosoma effulgens* is the common species in the neighborhood of Indianapolis, to which latitude all the accounts here given must be referred. Eastward occurs *Boleosoma olmstedi*, which is somewhat larger and has the cheeks thickly scaly. We are not quite sure that the change of color in Diplesium depends on the season, but our observations thus far indicate it.

[2] Not as represented in the figure, in which the body is also represented too deep. The cuts accompanying this article are outlines only and erroneous in many of the details. While of much value as giving a general idea of the Etheostomoids, nevertheless the authors disclaim any responsibility for them.

STANFORD LIBRARY

PLATE III.

STANFORD LIBRARY



T. Sinclair & Son, lith. Phila.

nedian line, — that have given him the name of tesselated larter, said by the books to be "common." But Boleosoma is a raver name, and we even prefer "Boly," for short. The head esembles that of Diplesium, but the habit of leaning forward over stone, resting on the front fins, gives a physiognomy even more rog-like; his actions however, are, rather bird-like, for he will trike attitudes like a tufted titmouse, and he flies rather than wims through the water. He will with much perseverance push is body between a plant and the side of the aquarium, and bal- nce himself on the slender stem. Crouching cat-like before a ail-shell, he will snap off the horns which the unlucky owner ushes timidly out. But he is often less dainty, and, seizing the nimal by the head, dashes the shell against the glass or a stone ntil he pulls the body out or breaks the shell. "Boly," alas! the "Quaker of our aquarium" only in appearance.

THE BLACK KNOT.

HE following article is an abstract, by Mr. B. D. Halsted, of a paper by Prof. W. G. Farlow published in the Bulletin of e Bussey Institution of March, 1876. It will be the endeavor give, with the aid of two of the three original plates,[1] a brief tice of the most important points concerning this destructive ngus.

Without doubt, the most striking disease of vegetable origin urring on fruit-trees in this country is that commonly known the black knot. The disease takes its name from the un- htly, black, wart-like excrescences, with which every one is niliar, on plum-trees and different kinds of wild and cultivated erries. It is found in all parts of our country east of the cky Mountains, and is so common and destructive that in some tricts one seldom sees a plum-tree free from the knot. An idea y be formed of the small crop of plums now raised in New gland from the fact that two dollars and a half were given in ston last autumn for a peck of damsons for preserving. In ne parts of New England, particularly in Maine and along sea-coast, the raising of cherries has also been almost aban-

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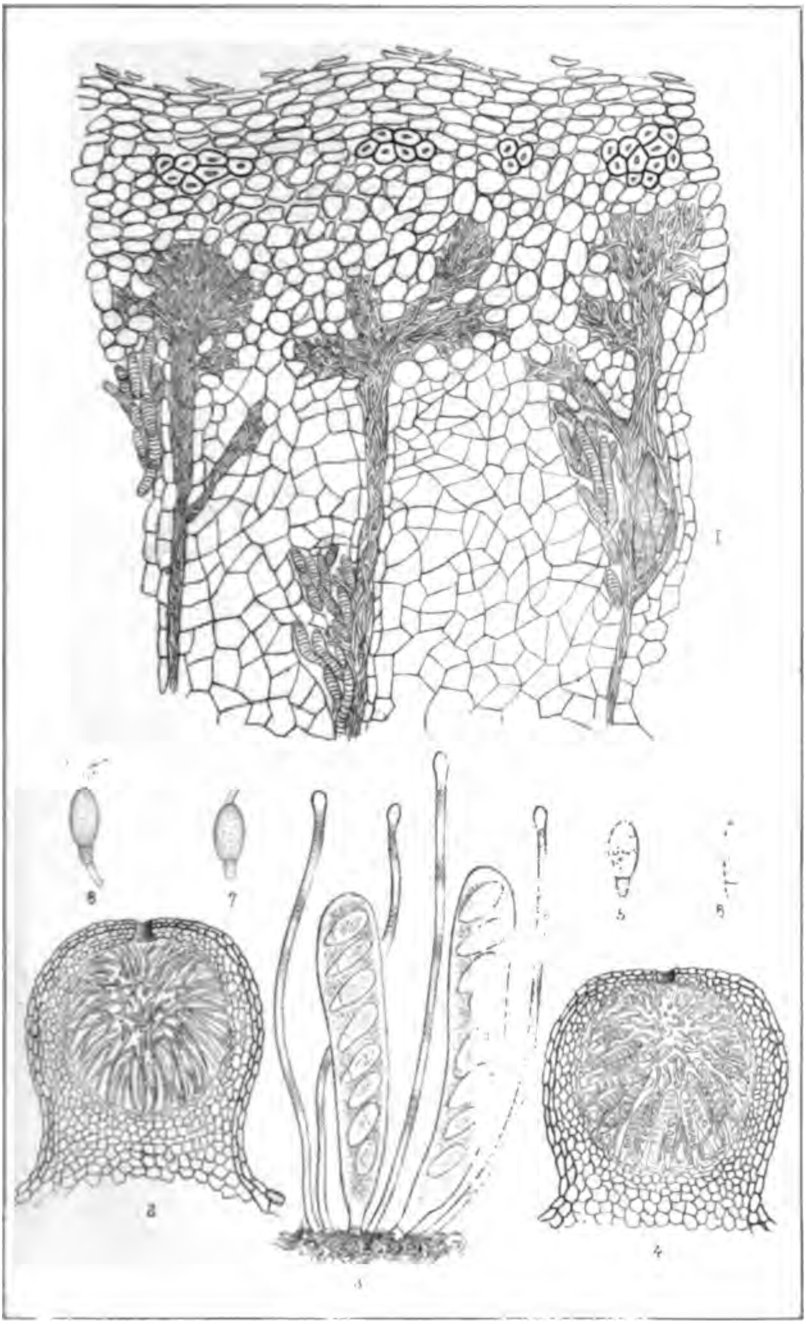
The sum of $500 was voted by the Trustees of the Massachusetts Society for noting Agriculture to aid Professor Farlow in his researches, and from this liberal opriation the expense of the plates was defrayed. Professor Farlow is himself onsible for the microscopic details of the plates, but whatever of beauty they may ess is entirely due to the skill of Mr. J. H. Blake, of the Museum of Comparative logy, Cambridge.

doned, in consequence of the ravages of the black knot. The disease is peculiar to America, and has been the bane of fruit-growers from early times; but although much has been written in agricultural papers about its injury to the fruit crop, the subject has been almost entirely neglected by botanists. In the present paper we shall consider the cause and prevention of the knot, and the question whether the disease is the same on plums and cherries. As a preliminary step, it will be well to trace the development of the knot as it occurs on a single species, and for this purpose the choke-cherry, *Prunus Virginiana* L., may be selected.

The size of the knots varies greatly, being found on the species of *Prunus* under consideration all the way from a few lines to several inches in length, with an average of two inches in circumference. The knot does not usually entirely surround the branch, but growing from one side, often causes the branch to bend or twist into an irregular shape. In the winter, when the branches are leafless, the knots are much more noticeable, and at this season they are often cracked and broken, worm-eaten and hollow.

In the swollen portions of the branch above and below the knot, sections under the microscope show the vegetative portion of the fungus in the form of minute threads, .0007 mm. in diameter, twisted together and extending from the cambium towards the outer portion of the stem, where they become separated as shown in Plate IV., Figure 1. The fungus first reaches the cambium either by the germination of spores on the surface of the branch, or by the mycelium proceeding from a neighboring knot. The part of the cambium free from these bundles of mycelial threads grows in the usual manner, and in an old branch a cross section shows at the end of the season one more "ring" or layer of wood on the sound than on the diseased side. From this it is to be concluded that the growing layer of tissue of the plum or cherry branch is the place from which the fungus begins its destructive work.

In the spring the swollen portion of the branch, whether it be on either side of an old knot or at the beginning of a new one, increases in size, and the mycelium soon reaches and bursts through the bark, so that by the time the choke-cherry is in flower the knot has reached nearly its full size, though differing from an old one in being still greenish in color and solid or pulpy in consistency.



"With a hand-lens one can see small hemispherical protuberances, which are the beginnings of the 'perithecia.' The whole surface of the protuberances is covered with filaments (Plate III., Figure 2) about .04 mm. to .06 mm. in height and .004 mm. in breadth, which are somewhat flexuous and frequently divided by cross-partitions. The filaments are more frequently simple, but sometimes branch. At the tip of the terminal joint, or more frequently a little to one side, is borne a spore .006 mm. in length, ovate and rather sharply pointed at the lower end. Not unfrequently two or three spores are borne on the upper joint, and others may also be produced on some of the lower joints. We have never seen any cross divisions in the conidial spores, which fall very early from their attachments. The conidia which we have just described spring directly from the surface of the perithecia. They continue to bear their spores until the latter part of summer, when they begin to dry up, and as winter sets in one finds only their shriveled remains." As autumn approaches, the knots assume their black color, the inner portions being either destroyed by insects or reduced to a powdery mass, with only the hard outer shell, which contains the perithecia, left in place. These perithecia are small pits or sacs which are scattered through the hard crust and contain the sexual spores, borne, always to the number of eight, in asci or cells. In Plate IV., Figure 4, is shown a highly magnified cross section through a perithecium, with the spore sacs attached to the wall. Figure 3 of the same plate gives a still more magnified view of two of the asci, with the spores somewhat regularly disposed; while springing from the wall of the perithecium and extending above the asci are the long and slender sterile threads called "paraphyses." "The asci grow slowly during the winter, and about the middle of January the spores begin to ripen. In the month of February they are found in perfection; but late in spring they are not so abundant or in such good condition. We first found a few ripe spores on the 17th of January; and in the second week of February, most of the knots examined contained ripe spores. . . . . The spores measure from .016 mm. to .02 mm. in length and from .008 mm. to .01 mm. in breadth. They are two-parted, as shown in Plate IV., Figures 5 and 6; one division being uniformly much smaller than the other, and not more than one quarter or one third as long. The spores are transparent and slightly granular. As they lie in the ascus, the small end almost invariably points downwards. Spores which ripen in February germinate in the course of from three to five days, when sufficiently moist."

Besides the conidial spores formed from the outside, and the ascospores from the inside, of the wall of the perithecia, there are still other forms of fruit, which are called stylospores. These spores are produced in cavities between the perithecia; a cross section of such a cavity is represented in Plate III., Figure 4, with a small portion more magnified in Figure 5, showing these bodies to be borne on long stalks and divided by partitions into four parts.

"Plate IV., Figure 2, represents a section through a cavity hardly distinguishable externally from the perithecia, which, instead of being filled with asci, is lined with slender filaments whose tips are somewhat incurved, and easily broken off, the central part of the sac being filled with them. We call these "spermogonia," from their resemblance to the bodies of the same name in lichens. They are much less common than the conidia or stylospores. Interspersed amongst the ascus-bearing perithecia, one finds tolerably frequently still other cavities which are much more flattened than the perithecia, which often, instead of appearing oval, on section seem almost triangular. They are lined with short, delicate filaments which end in a minute oval hyaline body. These small oval bodies are produced in immense numbers, and are discharged not singly, but in masses. They are more or less closely held together by a sort of jelly, and ooze out from the cavity in which they are produced in the form of tendrils reminding one of the toy called "Pharaoh's serpent." This last form is called the "pycnidia." It seems that this fungus does not lack for methods of propagating itself and continuing its species.

The knot on the choke-cherry, when compared with those on the plum and cultivated varieties of cherry, is seen to be slightly different in general appearance; but when viewed with the microscope they all prove to be identical, the difference noticeable to the naked eye being due to more favorable circumstances for its growth afforded by one species of *Prunus* than by another. On the plum it does not thrive as well as on the choke-cherry. The curculio deposits its eggs in the young pulpy knot, and from the punctures a gum soon exudes and on this coating a mold, *Trichothecium roseum* Lk., quickly develops, giving a peculiar pinkish color to the knot. "It is probably owing to the fact that the curculio stings the knots that so many persons have been led to believe that the knots themselves are of insect origin."

Schweinitz was the first to describe, under the name of *Sphæria*
rbosa, the fungus causing the black knot. At that time noth-
was known of the secondary forms of fruit of this group of
gi. Mr. C. H. Peck was the first to describe the conidia.

'rom a short discussion as to the position this species should
e in classification and the name it ought to bear, it is con-
led that until its related species are better known its old place
name had best be retained.

'he black knot is far from being of recent origin, and has
iished a subject about which vastly more has been written
was known. Many, especially the early writers, held it to
f insect origin, while, later, others have looked upon it as a
table growth, and still others included in its production the
ons of both these forms of life. During the last thirty years
insect theory has been gradually given up by the entomolo-
; but it still remains for many fruit-growers to accept the
as being of fungus origin. The proof given in the paper is
conclusive on this long-disputed point. "First, the knots
ot resemble the galls made by any known insect. Secondly,
ugh insects, or remains of insects, are generally found in old
s, in most cases no insects at all are found in them when
g. Thirdly, the insects that have been found by entomol-
s in the knots are not all of one species, but of several dif-
t species, which are also found on trees which are never
ted by the knot. On the other hand, we never have the
knot without the *Sphæria morbosa*, as was admitted by
is; and the mycelium of that fungus is found in the slightly
en stem long before anything which could be called a knot
nade its appearance. Furthermore, the *Sphæria morbosa* is
known to occur anywhere except in connection with the
."

ose who believe that there are two distinct species of the
have arrived at this conclusion from a too hasty generaliza-
pon incomplete observations. "Having seen some cherries
from the knot, although growing near diseased plum-trees,
thers, perhaps not near any plum-trees, covered with knots,
have jumped at the conclusion that there must be two dif-
fungi producing the knot: one on the cherry, derived from
ild cherry; another on the plum, derived from the wild
" This false inference comes from the fact that some
s of wild cherry, and also some cultivated varieties, are not
ted by the knot. "*Prunus serotina* Ehr., the rum-cherry,

and *Prunus Virginiana* L., the choke-cherry, are about equally common near Boston. The latter is very frequently attacked by the knot; the former never, as far as our experience goes, and we have examined hundreds of trees." In and around Boston the cultivated plum has been nearly destroyed by the knot, while over the same territory the wild plum is of rare occurrence, if found at all, showing that the disease must come from some species of cherry.

In all this long discussion of the black knot much confusion has grown out of the loose use of popular names. The choke-cherry of one person may not be the choke-cherry of another; and the bird or rum cherry in one section may bear other names in another part of the country.

With a knowledge of the nature of this contagious disease the remedy at once suggests itself: namely, to cut off the knots, together with the swollen portions of the branches, wherever and whenever they are found. In autumn, as soon as the leaves fall, the knots can be most easily seen, and all branches bearing them should be taken off and burned at once. Though the ascospores are not formed until late in the following winter, it was carefully observed that, were the knots left undestroyed, they would ripen after the branch was cut from the tree. The choke-cherry, bird-cherry, and wild plum furnish means for rapid propagation of the knot, and they should be gladly sacrificed for the good of their more worthy allies. Of the choke-cherry the writer says, "However opinions may differ as to its beauty, there can be only one as to its injurious influence on cherry and plum orchards; and it cannot be too strongly impressed upon fruit-growers that the choke-cherry is a most dangerous enemy, and should be destroyed."

Knowing the cause, nature, and means of propagation of the black knot, it remains for the fruit-growers to profit by their valuable instruction and use their best endeavors to destroy this pest. The article closes with a statement of the importance of keeping the disease within its present bounds. It is now peculiar to America, and any means of introducing it into other countries should be strenuously avoided.

EXPLANATION OF THE PLATES.

Plate III. Figure 1. *Sphæria morbosa* on the cultivated plum, as seen in autumn, natural size.

Figure 2. Section of knot on the choke-cherry in May, magnified six hundred diameters; *a*, mycelium; *b*, conidia.

Figure 3. Conidia more highly magnified.

Figure 4. Section through one side of a cavity containing stylospores. From azzard cherry.

Figure 5. Stylospores more highly magnified.

Plate IV. Figure 1. Section of choke-cherry stem, showing the mycelium before it s come to the surface, magnified six hundred diameters.

Figure 2. Spermogonia.

Figure 3. Asci and spores of *Sphæria morbosa* from the choke-cherry.

Figure 4. Perithecium with asci.

Figures 5, 6. Ripe ascospores.

Figures 7, 8. Ascospores germinating.

PROFESSOR TYNDALL ON GERMS.

UNDER this head, *Nature* gives an abstract of a paper read by Professor Tyndall before the Royal Society, January th, entitled On the Optical Deportment of the Atmosphere Reference to the Phenomena of Putrefaction and Infection. mong other things, he wished to free his mind, and if possible e minds of others, from the uncertainty and confusion which w beset the doctrine of "spontaneous generation." Pasteur s pronounced it "a chimera," and expressed the undoubting nviction that, this being the case, it is possible to remove para- ic diseases from the earth. We make a few extracts from this eresting article: —

"To the medical profession, therefore, and through them to manity at large, this question is one of the last importance. it the state of medical opinion regarding it is not satisfactory. a recent number of the *British Medical Journal*, and in an- er to the question, 'In what way is contagium generated and nmunicated?' Messrs. Braidwood and Vacher reply that not- thstanding 'an almost incalculable amount of patient labor, actual results obtained, especially as regards the manner of neration of contagium, have been most disappointing. Ob- vers are even yet at variance whether these minute particles, ose discovery we have just noticed, and other disease germs, always produced from like bodies previously existing, or ether they do not, under certain favorable conditions, spring o existence *de novo*.' . . .

'The result of the experiments showed that infusions of vari- substances exposed to the common air of the Royal Institu- a laboratory, maintained at a temperature of from 60° to 70° hr., all fell into putrefaction in the course of from two to four days. No matter where the infusions were placed, they were infallibly smitten. The number of the tubes containing the infusions was multiplied till it reached six hundred, but not one of them escaped infection.

"In no single instance, on the other hand, did the air, which had been proved moteless by the searching beam, show itself to possess the least power of producing bacterial life or the associated phenomena of putrefaction. The power of developing such life in atmospheric air, and the power of scattering light, are thus proved to be indissolubly united.

"The sole condition necessary to cause these long-dormant infusions to swarm with active life is the access of the floating matter of the air. After having remained for four months as pellucid as distilled water, the opening of the back door of the protecting case, and the consequent admission of the mote-laden air, suffice in three days to render the infusions putrid and full of life. . . .

"From the irregular manner in which the tubes are attacked, we may infer that, as regards *quantity*, the distribution of the germs in the air is not uniform. The singling out, moreover, of one tube of the hundred by the particular *bacteria* that develop a green pigment, shows that, as regards *quality*, the distribution is not uniform. The same absence of uniformity was manifested in the struggle for existence between the *bacteria* and the penicillium. In some tubes the former were triumphant; in other tubes of the same infusion the latter was triumphant. It would seem also as if a want of uniformity as regards *vital vigor* prevailed. With the self-same infusion the motions of the *bacteria* in some tubes were exceedingly languid, while in other tubes the motions resembled a rain of projectiles, being so rapid and violent as to be followed with difficulty by the eye. Reflecting on the whole of this, the author concludes that the germs float through the atmosphere in groups or clouds, with spaces more sparsely filled between them. The touching of a nutritive fluid by a bacterial cloud would naturally have a different effect from the touching of it by the interspace between two clouds. But as, in the case of a mottled sky, the various portions of the landscape are successively visited by shade, so, in the long run, are the various tubes of our tray touched by the bacterial clouds, the final fertilization or infection of them all being the consequence. The author connects these results with the experiments

Pasteur on the non-continuity of the cause of so-called sponta- ous generation, and with other experiments of his own.[1]

" On the 9th of November, a second tray, containing one hun- ed tubes filled with an infusion of mutton, was exposed to the r. On the morning of the 11th, six of the ten nearest the stove d given way to putrefaction. Three of the rows most distant m the stove had yielded, while here and there over the tray rticular tubes were singled out and smitten by the infection. the whole tray of one hundred tubes, twenty-seven were her muddy or cloudy on the 11th. Thus, doubtless, in a tagious atmosphere are individuals successively struck down. the 12th, all the tubes had given way, but the differences in ir contents were extraordinary. All of them contained *bac- ia*, some few, others in swarms. In some tubes they were w and sickly in their motions, in some apparently dead, while others they darted about with rampant vigor. These differ- es are to be referred to changes in the germinal matter, for same infusion was presented everywhere to the air. Here we have a picture of what occurs during an epidemic, the erence in number and energy of the bacterial swarms resem- g the varying intensity of the disease. It becomes obvious n these experiments that of two individuals of the same pop- ion, exposed to a contagious atmosphere, the one may be rely, the other lightly attacked, though the two individuals be as identical, as regards susceptibility, as two samples of and the same mutton infusion.

The author traces still further the parallelism of these actions the progress of infectious disease. The *Times* of January contained a remarkable letter on Typhoid Fever, signed D.,' in which occurs the following remarkable statement: one part of it (Edinburgh), congregated together and in- ted by the lowest of the population, there are, according to corporation return for 1874, no less than 14,319 houses or lings — many under one roof, on the "flat" system — in

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hospital practice, the opening of a wound during the passage of a bacterial would have an effect very different from the opening of it in the interspace be- two clouds. Certain caprices in the behavior of dressed wounds may possibly ounted for in this way. Under the heading Nothing new under the Sun, sor Huxley has just sent me the following remarkable extract: "Uebrigens man sich die in der Atmosphäre schwimmenden Thierchen wie Wolken den- it denen ganz leere Luftmassen, ja ganze Tage völlig reinen Luftverhältnisse ln." (Ehrenberg, Infusions Thierchen, 1838, p. 525.) The coincidence of ology is surprising, for I knew nothing of Ehrenberg's conception. My ls," however, are but small miniatures of his.

which there are no house connections whatever with the street sewers, and consequently no water-closets. To this day, therefore, all the excrementitious and other refuse of the inhabitants is collected in pails or pans, and remains in their midst generally in a partitioned-off corner of the living-room until the next day, when it is taken down to the streets and emptied into the corporation carts. Drunken and vicious though the population be, herded together like sheep, and with the filth collected and kept for twenty-four hours in their very midst, it is a remarkable fact that typhoid fever and diphtheria are simply unknown in these wretched hovels.'

"This case has its analogue in the following experiment, which is representative of a class. On November 30th a quantity of animal refuse, embracing beef, fish, rabbit, hare, was placed in two large test-tubes opening into a protecting chamber containing six tubes. On December 13th, when the refuse was in a state of noisome putrefaction, infusions of whiting, turnip, beef, and mutton were placed in the other four tubes. They were boiled and abandoned to the action of the foul "sewer gas" emitted by their two putrid companions. On Christmas Day the four infusions were limpid. The end of the pipette was then dipped into one of the putrid tubes, and a quantity of matter comparable in smallness to the pock-lymph held on the point of a lancet was transferred to the turnip. 'Its clearness was not sensibly affected at the time; but on the 26th it was turbid throughout. On the 27th, a speck from the infected turnip was transferred to the whiting; on the 28th, disease had taken entire possession of the whiting. To the present hour the beef and mutton tubes remain as limpid as distilled water. Just as in the case of the living men and women in Edinburgh, no amount of fetid gas had the power of propagating the plague as long as the organisms which constitute the true contagium did not gain access to the infusions.

"The universal prevalence of the germinal matter of *bacteria* in water has been demonstrated with the utmost evidence by the experiments of Dr. Burdon Sanderson. But the germs in water are in a very different condition, as regards readiness for development, from those in air. In water they are thoroughly wetted and ready, under the proper conditions, to pass rapidly into the finished organism. In air they are more or less desiccated, and require a period of preparation more or less long to bring them up to the starting-point of the water-germs. The rapidity of

velopment in an infusion, infected by either a speck of liquid
ntaining *bacteria* or a drop of water, is extraordinary. On
anuary 4th a thread of glass almost as fine as a hair was
pped into a cloudy turnip infusion, and the tip only of the
ass fibre was introduced into a large test-tube containing an in-
sion of red mullet. Twelve hours subsequently, the perfectly
llucid liquid was cloudy throughout. A second test-tube con-
ining the same infusion was infected with a single drop of the
stilled water furnished by Messrs. Hopkin and Williams;
elve hours also sufficed to cloud the infusion thus treated.
recisely the same experiments were made with herring, with
e same result. At this season of the year, several days' expos-
e to the air are needed to produce so great an effect. On De-
mber 31st a strong turnip-infusion was prepared by digesting
in slices in distilled water at a temperature of 120° Fahr. The
fusion was divided between four large test-tubes, in one of
ich it was left unboiled, in another boiled for five minutes, in
e two remaining ones boiled and, after cooling, infected with
e drop of beef-infusion containing *bacteria*. In twenty-four
urs the unboiled tube and the two infected ones were cloudy,
unboiled tube being the most turbid of the three. The infu-
n here was peculiarly limpid after digestion; for turnip it was
ite exceptional, and no amount of searching with the micro-
pe could reveal in it at first the trace of a living bacterium;
l germs were there which, suitably nourished, passed in a
gle day into bacterial swarms without number. Five days
ve not sufficed to produce an effect approximately equal to
s in the boiled tube, which was uninfected, but exposed to the
nmon laboratory air.

"There cannot, moreover, be a doubt that the germs in the air
er widely among themselves as regards *preparedness* for de-
opment. Some are fresh, others old; some are dry, others
ist. Infected by such germs, the same infusion would require
erent lengths of time to develop bacterial life. This remark
lies to and explains the different degrees of rapidity with
ich epidemic disease acts upon different people. In some, the
ching period, if it may be called such, is long, in some short,
differences depending upon the different degrees of prepared-
s of the contagium."

ON THE FORMER CLIMATE OF THE POLAR REGIONS.[1]

BY PROFESSOR A. E. NORDENSKIÖLD.

ONLY a few years ago it was looked upon as an article of faith among geologists that the whole globe was once in a melted, incandescent state, and that the conditions of temperature now prevailing on the surface of the earth have been in process of time produced by the slow, gradual cooling of the once fused and glowing mass. It then appeared so natural that, in consequence of the earth's internal heat, a tropical climate should extend from pole to pole, that no special weight was attached to the evidences of this fact which geology was at that time able to produce. The Dane Giesecke's and the English Scoresby's specimens of fossil plants from the east and west coasts of Greenland, evidencing a warm climate there, attracted so little attention that neither they, nor the fossil remains of Saurians found by the famous Arctic traveler, Sir Edward Belcher, in the American Polar Archipelago, could be found in the museums to which they had been confided.

It was not till geologists had become fully convinced that the gradual transition from the time when a warm climate was supposed to have prevailed over the whole earth and the present time has at least once been interrupted by a period during which the greater part of the European and American continents were covered by mighty glaciers, that the geological theory of climates was taken up with real interest. People began gradually to perceive that, even supposing the earth really to have once been in a state of glowing fusion, the cooling must already at the Cambrian and Silurian epochs have proceeded so far that the quantity of heat which the earth lost by radiation was fully compensated by that which it received from the other heavenly bodies. It has also been supposed that the cause of the glacial period — when vast ice mountains scattered bowlders from Scandinavia over the plains of Northern Germany, and when the Swiss Alps formed the centre of an icy desert similar to the present Greenland — is to be sought for in some trifling changes in the form of the earth's orbit and the inclination of the equator, which have taken place and continue to take place periodically after the lapse of thousands or hundreds of thousands of years. The same causes which have once produced the glacial period have thus happened, not only during this last period nearer to our own ie, but also many times before; and there is reason to suppose t they were also then followed by somewhat similar results, that is to say, that the cold and the warm eras have many ies alternated on the surface of the earth. In consequence of s, it has become a matter of the utmost importance to science obtain by real observation accurate information as to the state temperature on the earth's surface during as many of the ferent geological periods as possible. When in our days a entific question is seriously propounded, it is seldom long be- e it is answered; and even in the instance before us we have late years received numerous contributions to geological clima- ogy from lands the geographical situation of which, in the ghborhood of the pole, renders them best fitted to yield in- mation of this kind.

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[1] A lecture delivered at the anniversary meeting of the Royal Swedish Academy of Science, March 31, 1875, and translated for The Geological Magazine.

The geology of the polar tracts can in two different ways pply us with information concerning the former climate, partly a comparison of the fossil animals and plants there found with sting forms that live under certain determinate climatic con- ons, partly by an accurate examination of the various strata different geological ages, with a view to ascertain whether se present any of the indications which usually distinguish cial formations.

Ve now possess fossil remains from the polar regions belong- to almost all the periods into which the geologist has divided history of the earth. The Silurian fossils which McClintock ight home from the American Polar Archipelago, and the man naturalists from Novaja Semlja, as also some probably onian remains of fish found by the Swedish expeditions on coasts of Spitzbergen, are, however, too few in number, and ng to forms too far removed from those now living, to furnish sure information relative to the climate in which they have d.

nmediately after the termination of the Devonian age, an nsive continent seems to have been formed in the polar basin h of Europe, and we still find in Beeren Island and Spitz- en vast strata of slate, sandstone, and coal, belonging to that d, in which are imbedded abundant remains of a luxuriant tation, which, as well as several of the fossil plant-remains ght from the polar regions by the Swedish expeditions, have examined and described by Professor Heer, of Zürich. We certainly meet with forms, vast *Sigillaria*, *Calamites*, and es of *Lepidodendron*, etc., which have no exactly corresponding representatives in the plants now existing. Colossal and luxuriant forms of vegetation, however, indicate a climate highly favorable to vegetable development. A careful examination of the petrifactions taken from these strata shows also so accurate an agreement with the fossil plants of the same period found in many parts of the continent of Central Europe, that we are obliged to conclude that at that time no appreciable difference of climate existed on the face of the earth, but that a uniform climate extremely favorable for vegetation — but not on that account necessarily tropical — prevailed from the equator to the poles.

The sand and slate beds here mentioned do not contain any marine petrifactions, whence we may conclude that they have been formed in lakes or other hollows in an extensive polar continent. In Beeren Island and Spitzbergen they are, however, covered by beds of limestone and siliceous rock, which form the chief material in Beeren Island, and of several considerable mountains on the southern side of Hinloopen Strait, and the innermost bays of Ice-fjord in Spitzbergen. The manner in which these mountains rise several thousand feet above the surrounding snow desert, their regular form, crowned with vast masses of dark volcanic rock divided into vertical columns, the siliceous strata forming perpendicularly-scarped terraces, and the tendency of the calcareous beds to fall away and form natural arches, give to these mountains the appearance of ruins of colossal ancient fortifications and temples, unequaled in sublime and desolate magnificence. Here, indeed, we meet with the monumental gravestones of a long-past age. The rock is in fact formed almost entirely of shells of marine mollusca, fragments of corals, and bryozoa of the age of the mountain-limestone. We have then, here, not only a proof that the ancient polar continent sank down again and gave place to a deep polar ocean, but also, in the correspondence of the corals, shells, and other associated organic remains with those met with in more southerly tracts, an indication that the warm polar climate remained unchanged.

The mountain-limestone period was followed by an era during which the richest coal-beds of England, Belgium, and America were formed, and which has accordingly received the name of the coal period. A new distribution of land and water had now taken place, continents had again arisen in the polar tracts, in the sandstones and argillaceous strata of which we again find, at Bell Sound, on the western coast of Spitzbergen, fossil plants t bear witness to a rich polar vegetation developed under a rm climate. Among these, however, we miss the species of ge-leaved fern so abundant in the coal-beds of more southerly ds, a circumstance which may possibly indicate a certain dif- ence of climate as existing at that epoch, unless, as is more bable, the circumstance is merely the result of the insuffi- ncy of the materials brought from but one single arctic local- .

The only relics from the polar regions belonging to the suc- ding era, the Triassic, are those of marine animals, amongst ich a considerable portion consists of large, shell-clad Cepha- oda related to Ammonites, Nautilus, etc., which, judging from habits of the forms still existing in our time, could assuredly e only lived in a warm ocean. More certain information rela- to the nature of the polar climate at that time is afforded by tions of skeletons of colossal Sauria, — one form, *Ichthyosaurus tris*, seems to have reached a length of twenty or thirty feet, which, together with vast coprolite beds, are found in great ndance inclosed in the Triassic strata of Ice-fjord, and which ng the now existing fauna have their nearest representatives he crocodiles on the sunny banks of the Nile, or perhaps er in the marine lizard, *Amblyrhynchus*, met with in the pagos Isles. That multitudes of these cold-blooded animals at that time in the vicinity of the eightieth degree of lati- attests beyond all doubt climatal conditions very different those of the present day.

the entrance of Ice-fjord and at Mount Agardh, in Stor- , the Triassic strata are covered with marine formations be- ng to the immediately subsequent geological era, the Jura d, and, as far as we can judge from the few fossil remains rto discovered in these strata, no diminution had as yet place in the warmth of the polar climate. But great es now came to pass in the portion of the polar basin north rope, the ocean being again transformed into a continent, , though shattered and reduced, still exists up to the pres- ime. The upper portion, therefore, of the Jura formation itzbergen does not contain any marine organisms, but in ace of them beds of sandstone and slate, with coal-seams npressions of plants. From the strata belonging to that et with at Cape Boheman, in Ice-fjord, situated between venty-eighth and seventy-ninth degrees of latitude, the sh expeditions have brought home numerous impressions of palm-like cycadeæ and coniferæ, the representative species of which now flourish in the neighborhood of the tropics. This already leads to the supposition of a warm climate, which supposition is further confirmed by a comparison with the European fossil flora of the same date, which indicates that the climate of Spitzbergen did not then materially differ from that of Central Europe.

The Swedish expeditions have also succeeded in obtaining, partly from Greenland and partly from Spitzbergen, from two separate epochs of the Cretaceous era, extensive collections of fossil plants, lately described by Professor Heer in the Transactions of the Royal Swedish Academy. By this we have been enabled not only to determine the epoch when differences of climate first began to show themselves on the surface of the earth, but also pretty closely to follow an extremely remarkable change in the appearance of the vegetable world which took place during the course of that period.

Within the polar basin we meet with the lowest division of the Cretaceous age on the north side of the Noursoak peninsula, in Northwestern Greenland. The crown of the hills is here composed of black, ancient lava-streams and immense beds of volcanic tuff, hardened in process of time into solid rock.

Over these volcanic formations now rests a covering of perpetual ice, and beneath them on the sea-shore vast strata of sand are discovered, containing inconsiderable coal-beds, interstratified with clay-beds and a fine-grained argillaceous shale singularly fitted for preserving the impressions of fossils that have been imbedded in it. These plants belong to the lowest portion of the Cretaceous age, and among the collections brought from this spot, Heer has succeeded in distinguishing seventy-five different species, among which are thirty ferns, nine cycadeæ, and seventeen coniferæ.

The third part of the ferns belongs to one genus, *Gleichenia*, which still flourishes in the neigborhood of the tropics and warmer parts of the temperate zone, and the same remark holds good of the cycadeæ, most of which are referable to the genus *Zamia*, species of which we meet with within the tropics, as also of the coniferæ, some of which are nearly related to forms still existing in Florida, Japan, and California. From this Heer draws the conclusion, that in the early part of the Cretaceous period the climate of the now ice-covered Greenland was somewhat like that which now prevails in Egypt and the Canary Isles.

Among the ferns, cycadeæ, and coniferæ of Noursoak peninsula,
ere found a few impressions of a species of the poplar, *Populus*
rimæva, which formed the only and at the same time the old-
t known representative of the forest vegetation now prevailing
the temperate zone. Nevertheless the vegetation of the arctic
acts was already during the Cretaceous period undergoing a
mplete transformation. Evidence of this has been obtained
om the same locality, Atanekerdluk, on the south side of the
oursoak peninsula, from which such magnificent remains of
ctic vegetation of the Tertiary period had previously been ob-
ined, from strata at a somewhat higher level. Here, out of
e talus that has fallen from the lofty fells, some black and
erably easily crumbling strata of shale protrude, among which,
careful inspection, impressions of plants may be discovered
longing to the Cretaceous formation, not to the lower, but
upper portion of it. The vegetation is here quite differ-
t. The ferns and cycadeæ have disappeared, and in their place
find deciduous trees and other dicotyledons in astonishing
iety and forms, among which a species of fig may be men-
ned, of which not only the leaves, but also the fruit, have been
ained in a fossil state; two species of magnolia, etc. The
nate that then prevailed over the whole globe was therefore
l warm and luxuriant, even if, at least in the arctic regions,
siderably modified from what it formerly had been, inasmuch
that the flowerless vegetation (which was now beginning to
out), as far as we can judge from its present representatives,
ferns, required a warm, humid climate, whereas the new
ns with their luxuriant flowers, which now began to charac-
ze the vegetable world, required, in order to develop all the
ndeur of their colors, a clear and sunny sky. The disappear-
of sundry tropical and sub-tropical forms that are met with
he older Cretaceous strata has led Heer to the conclusion
difference of climate at different latitudes was now begin-
to show itself, and he calls attention to the circumstance
this takes place synchronously with the development of the
tyledonous plants in greater variety.

nhappily, in the arctic regions no fossil remains belonging
ne Eocene age, which immediately succeeded the Cretaceous
od, have hitherto been met with, and we are therefore desti-
of the actual data necessary for ascertaining its climatic
acter. But the next following, or Miocene, age places at
disposal abundant materials in the magnificent remains of

plants obtained, we may say, from all parts of the polar basin and its vicinity: from West Greenland by Inglefield, McClintock, Rink, Torell, Whymper, and the Swedish expeditions; from East Greenland by Payer; from Alaska by Mr. Furnhjelm; from Sagalin by Admiral Furnhjelm; and from different localities of Spitzbergen by the Swedish expeditions.[1] The spots where remains of this period are found are frequently distinguished by their astonishing abundance of fossil plant-remains.

For example, at a place in Spitzbergen which we have called Cape Lyell, after the lately-deceased great English geologist, the rocks on the shore for a distance of several hundred feet form a continuous herbarium, where every stroke of the hammer brings to light an image of the vegetation of a long-past age, when the forest vegetation of these tracts consisted of the swamp-cypress of Texas (*Taxodium distichum*), of gigantic sequoias, relations or ancestors of California's mammoth tree, of large-leaved birches, limes, oaks, beeches, planes, and even magnolias. The place is situated in about 77° 35′ N. lat., on the south side of the entrance to Bell Sound, on the western coast of Spitzbergen. At the foot of the cliff, on one or two barren heaps of gravel, one may discover shoots an inch long of the polar willow, sole representative of the present vegetation of the locality. Just off the shore the ocean currents drive icebergs, which have fallen from the neighboring glaciers, backwards and forwards, and the crown of the rock itself forms the limit of a mighty glacier, which threatens within a few years to bury, under an icy covering of several hundred feet thickness, not only the little vegetation that exists here, and which in the summer weeks is sometimes adorned with charming colors, but also the memorials of the ancient glorious age now preserved within its rocks.

By a careful examination of the rich materials here accessible, and by a comparison of the petrifactions with those of the same period found in more southerly localities, Heer has shown that already in the Miocene era considerable variety of climate existed on the face of the earth, though even the pole at that time enjoyed a climate fully comparable with that of Central Europe now. The then flora of Europe had almost entirely an American character, and there are many reasons for supposing that the continents of Europe and America were at that time united, and ounded on the south by an ocean extending from the Atlantic ver the present deserts of Sahara and Central Asia to the Pacific.

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[1] We may also mention the evidence of an arctic Miocene flora obtained by Sir John Richardson from fine indurated clay-beds, associated with coal-seams, on the Mackenzie River, near Great Bear Lake, from which seventeen species of fossil plants have been identified by Heer. — EDIT. GEOL. MAG.

Between the Miocene and the present era are two important eriods, the Pliocene and the Glacial, which to us are particu-arly deserving of attention, inasmuch as that during them man, he lord of creation, seems first to have made his appearance. That during the latter of these periods vast masses of ice covered t least all the northern part of Europe is a well-known fact; ut concerning the nature of the transition from the glorious limate of the Miocene age to the Glacial period we possess no nowledge whatever founded on actual observation. Probably t some future time contributions towards the solution of this nportant question may be found amongst the mountain masses hat occupy the peninsula between Ice-fjord and Bell Sound in pitzbergen, or in some parts of the basalt region of Northwest-rn Greenland. In the interior of Ice-fjord and at several other aces on the coast of Spitzbergen, one meets with indications ther that the polar tracts were less completely covered with ice ring the Glacial era than is usually supposed, or that, in con-rmity with what has been observed in Switzerland, inter-glacial riods have also occurred in the polar regions. In some sand-ds not very much raised above the level of the sea, one may in ct find the large shells of a mussel (*Mytilus edulis*) still living the waters encircling the Scandinavian coast. It is now no nger found in the sea around Spitzbergen, having been prob-ly rooted out by the ice-masses constantly driven by the ocean rrents along the coasts.

From what has been already stated, it appears that the animal d vegetable relics found in the polar regions imbedded in ata deposited in widely separated geological eras uniformly tify that a warm climate has in former times prevailed over e whole globe. *From palæontological science no support can obtained for the assumption of a periodical alternation of rm and cold climates on the surface of the earth.*

A careful investigation of the structure of the different sedi-ntary strata leads to the same result. We are now very well quainted with the origin and nature of the various strata, the stance of which has been supplied by the destructive opera-n of glaciers on the surrounding and subjacent mountain sses, and we can point out certain marks by which these ata may be distinguished from other non-glacial deposits. In these last, one very rarely meets with any large stone bowlders, which have fallen from some neighboring cliff and been imbedded in sand or clay, either directly, and, if so, close to the place where originally found, or else after having in the spring been moved a greater or less distance by river ice. In glacial formations, on the contrary, as one may gather from the study of the strata in Scandinavia that belong to the glacial period, erratic blocks transported on icebergs to far-distant regions play an important part. If a climate similar to that which now prevails in the arctic regions has several times during various geological eras existed in the neighborhood of the pole, one has reason to expect that sandstones inclosing large bowlders should often be met with in these tracts.

But this is by no means the case, though such formations, if they exist on a large scale, could hardly escape observation.

The character of the coasts in the arctic regions is especially favorable to geological investigations. While the valleys are for the most part filled with ice, the sides of the mountains in summer, even in the eightieth degree of latitude, and to a height of one thousand or fifteen hundred feet above the level of the sea, are almost wholly free from snow. Nor are the rocks covered with any amount of vegetation worth mentioning, and, moreover, the sides of the mountains on the shore itself frequently present perpendicular sections, which everywhere expose their bare surfaces to the investigator. The knowledge of a mountain's geognostic character, at which one in more southerly countries can only arrive after long and laborious researches, removal of soil, and the like, is here gained almost at the first glance; and as we have never seen in Spitzbergen nor in Greenland, in these sections, often many miles in length, and including, one may say, all formations from the Silurian to the Tertiary, any bowlders even as large as a child's head, there is not the smallest probability that strata of any considerable extent, containing boulders, are to be found in the polar tracts previously to the middle of the Tertiary period.

Since, then, both an examination of the geognostic condition and an investigation of the fossil flora and fauna of the polar lands show no signs of a Glacial era having existed in those parts before the termination of the Miocene period, we are fully justified in rejecting, on the evidence of actual observation, the hypotheses founded on purely theoretical speculations, which assume the many times repeated alternation of warm and glacial climates between the present time and the earliest geological ages.

RECENT LITERATURE.

ANDERSON'S MANDALAY TO MOMIEN.[1] — Mandalay is the capital of Burma, and Momien an important town in the province of Yunnan, Western China. The two British expeditions of which Dr. Anderson ives a narrative was for the purpose of establishing commercial relations etween the British in Burma and the rich provinces of Western China. Both missions were repulsed and entirely unsuccessful, but much informaion concerning these remote regions was collected by Dr. Anderson, and as been given to the public in this handsome volume. The population a motley one, the Burmese intermingling with the Chinese, though oth live in different quarters of the same towns, and both are confined osely to their walls and fortifications by the fierce hill tribes on the order.

Few notes on the natural history of the country have been recorded, ough "a full and illustrated report is in active preparation." The mous tame fish of "the little rocky island of Theehadaw, which boasts e only stone pagoda in Burma, and is resorted to by numbers of pilims at the great Buddhist festival in March," are briefly mentioned in e following words: "Having supplied ourselves with rice and plantains, e boatmen called 'Tit-tit-tit.' Soon the fish appeared, about fifty yards f, and after repeated cries they were alongside, greedily devouring the fering of food. In their eagerness they showed their uncouth heads d great part of their backs, to which patches of gold leaf, laid on by cent devotees, still adhered. So tame were they that they suffered emselves to be stroked, and seemed to relish having their long feelers lled. One fellow, to whom a plantain skin was thrown, indignantly ected it, and dived in disgust."

While Burma is rich in ruined temples and towns, the prehistoric mains are also abundant. Stone celts are often turned up by the w in Yunnan as with us. "A large number of those purchased small, beautifully cut forms, with few or no signs of use, and made some variety of jade; but there is no reason to doubt the authenticity the larger forms which were brought to us. Bronze celts are also nd, but are valued at their weight in gold; we managed, however, to rchase one at Manwyne on the return journey. It belongs to the keted type of celts without wings. The composition of the bronze is same as that of the celts found in northern Europe: tin, 10; copper, "

he narrative has been prepared with evident care, and will be useful comparison with the relations of the recent French expedition to

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[1] *Mandalay to Momien.* A Narrative of the Two Expeditions to Western China of 8 and 1875, under Col. E. B. Sladen and Col. Horace Browne. By JOHN ANSON, M. D., etc. With Maps and Illustrations. London. 1876. 8vo, pp. 479. millan & Co. $7.50.

Cochin China, of which finely illustrated accounts are appearing in *Globus*, the early numbers of which for the present year also contain some fine views of Yunnan.

THE GEOLOGICAL RECORD FOR 1874.[1] — This useful work is apparently a complete bibliography of all works, papers, and notes, on geology, mineralogy, and palæontology, published during the year 1874. It will be of course indispensable to American laborers in these fields, especially to those who do not have access to large libraries. The work seems to have been prepared with thoroughness, as there are twenty-seven contributors besides the editor, and it is accompanied by an index. The Record is divided into eight sections, namely, Stratigraphical and Descriptive Geology, Physical Geology, Applied and Economic Geology, Petrology, Mineralogy, Palæontology, Maps and Sections, Miscellaneous and General. Brief summaries of the most important works and essays give it a great value to the working geologist. There are more than two thousand entries.

JOHNSON'S CYCLOPÆDIA.[2] — With Professors F. A. P. Barnard and A. Guyot as editors-in-chief of this compact and useful cyclopædia, the reader may be assured that the articles upon scientific topics are reliable, accurate, and fresh. The associate editors are twenty-seven in number, embracing several of our leading scientists, and there are five assistant editors, whose names are well known in scientific and literary circles. The editors claim that of the articles "not fewer than two or three hundred, at the smallest estimate, are articles upon topics of interest in science, letters, and constructive art, of which the titles do not appear in any contemporary work of the kind; many of them having been, in fact, suggested by the recent progress of scientific discovery or literary research." We notice, in looking hastily through the second volume, articles by the following scientists: Barnard, Chandler, Cooke, Dawson, De Gubernatis, Gill, Goodale, Gray, Guyot, Hitchcock, Hunt, Packard, Riley, Verrill, Willey, Woodward, and Yule.

RECENT CONTRIBUTIONS TO NORTH AMERICAN MAMMALOGY. — During the last few months several important papers have appeared relating to the mammals of North America, chiefly by Dr. Elliott Coues and Dr. Theodore Gill. It is now several years since Dr. Coues began to divide his labors between the North American mammals and birds, his attention having formerly been given almost exclusively to the latter. The first general results of his work upon the mammals appeared in the form of a Synopsis of the Muridæ of North America.[3] This brochure of twenty-four pages is based on the material ("several thousand specimens") in the Museum of the Smithsonian Institution, and is stated to be an abstract of a memoir[1] in which the characters of the varieties, species, and higher groups are to be given, with synonymy, bibliography, etc. In this paper the family *Muridæ* is taken in its usual acceptation, with the exclusion of the genus *Jaculus* (= *Zapus*), formerly included among the *Muridæ*. The four introduced species, namely, the common house rats and mice, are mentioned merely by name, but the principal ynonomy in the cases of the indigenous species, generic and subgeneric liagnosis, and the geographical distribution of the species and varieties re also added. Of the genus *Neotoma* four species are given, including ne (*N. magister*) fossil from the caves of Pennsylvania. The others re *N. Floridana*, under which are placed *N. Mexicana* and *N. micropus* f Baird's General Report on the Mammals of North America; *N. uscipes*, and *N. cinerea*, the latter embracing also *N. occidentalis* of 3aird's General Report. The species of *Sigmodon* are reduced to one, *S. Berlandieri* Baird and *Hesperomys Tolticus* De Saussure being re-erred to *S. hispidus*. The species of *Hesperomys* are also greatly re-uced in number, and are placed in three subgenera: *Vesperimus*, here rst characterized, and *Onychomys* and *Oryzomys* of Baird. Of the ubgenus *Vesperimus* six species are recognized, including two from lexico, one of which is described as new. The other four are *H. leuco-us*, with four varieties (*leucopus*, *gossypinus*, *Sonoriensis*, *eremicus*, and *ureolus*), *Michiganensis*, and *Californicus*. Under variety *leucopus* are cluded no less than fourteen nominal species of previous authors, while vo others appear under variety *aureolus*. The subgenus *Onychomys* cludes two species, one of which (*torridus*) is described as new from rizona; the other (*leucogaster*) includes also the *Mus Missouriensis* Audubon and Bachman. The subgenus *Oryzomys* embraces the ngle species *palustris*; making altogether nine North American species *Hesperomys*. *Ochetodon* is described as a new genus, with three species ven as well-established and two that are doubtful. In a foot-note, under *chetodon*, the genus *Ruthrodon* is characterized, and diagnosis given of two subgenera, one of which (*Euneomys*) is new.

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[1] *The Geological Record for* 1874. An Account of Works on Geology, Mineralogy, and Palæontology, published during the Year. Edited by WILLIAM WHITTAKER. London: Taylor and Francis. 1875. 8vo, pp. 397.

[2] *Johnson's New Universal Cyclopædia.* A Scientific and Popular Treasury of Useful Knowledge. Illustrated with Maps, Plans, and Engravings. In 4 vols. Vol. ii. 1876. I—Lichens. Royal 8vo, pp. 1767. New York: A. J. Johnson and Son.

[3] Proceedings of the Academy of Natural Sciences, Philadelphia, 1874.

In the arvicoline group (subfamily *Arvicolinæ*) *Evotomys* is diagnosed a new genus, with one species, the *netelies* of Pallas, which is re-rded as circumpolar in its distribution, and as shading southward in orth America into variety *Gappari* (= *Arvicola Gappari* auct.). The l genus *Arvicola* is divided into four subgenera, namely, *Myonomes* f., *Chilotus* and *Pedomys* Baird, and *Pitymys* McMurtrie, and em-aces six species. To the old *A. riparius* Ord, or the common meadow mouse of North America, are referred no less than eighteen specific names of former authors, while two other species (*Townsendii* and *xanthognathus*) are only provisionally regarded as distinct from this. The other three species of the old genus *Arvicola* have each also several synonyms, the *A. curlatus* of Cope (from California) being regarded as a variety of *austerus*, and a new variety of *pinetorum* is added, from Southeastern Mexico, a region where the genus was long supposed to be unrepresented. The subgenus *Synaptomys* Baird is raised to generic rank, and embraces the single species *Cooperi*, formerly referred to *Myodes*.

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[1] This memoir forms the first of the Monographs of the North American Rodentia Coues and Allen, now publishing in Dr. Hayden's quarto series of Reports of the ited States Geological and Geographical Survey of the Territories. The mono-aph of the Muridæ, we are informed, is already in type and will shortly be issued.

The lemmings of America are reduced to two species, which are referred to two genera — *Myodes* as restricted and *Coniculus* Wagler. The one (*M. obensis*) is confined to the western portions of arctic America, while the other (*C. huelsonius*) is found throughout the Arctic regions generally, and includes several nominal species. The muskrat (*Fiber zibthicus*) closes the list of the North American *Muridæ*.

In no group of North American mammals have such extensive changes been as yet made as Dr. Coues has here found it necessary to adopt; few groups, too, have so much needed careful revision, or present a more difficult field of inquiry. The vast amount of material Dr. Coues has had as a basis for his work, and the evident care he has exercised in its elaboration, lead us to look forward with great interest to the appearance of the promised fuller exposition of the group.

Almost simultaneously with the appearance of this synopsis in its original place of publication, it was also reissued, with additions, as one of the publications of the Northern Boundary Commission, as the "first of a series of preliminary zoölogical reports which may appear from time to time, during the elaboration of the material secured by the Boundary Commission."[1] The additions appear to consist mainly of a list of ten species collected during the survey, with notes on their distribution.

As previously noticed, Dr. Coues, in his definition of the family *Muridæ*, excluded from it the genus *Jaculus*. This genus he has since raised to the rank of a distinct family,[2] to which he has given the name *Zapodidæ*. The results of his investigation of this species he summarizes as follows: (1.) That there is at present only one known pecies of *Zapus*. (2.) That this species, usually referred to the *Muridæ*, liffers from the *Muridæ* to a degree warranting its recognition as a dis- inct family, as was done by Dr. Gill in 1872. Its principal characters ire the presence of an upper premolar not found in *Muridæ* proper, the lifferent and peculiar construction of the ante-orbital foramen, and the altatorial development of the hind limbs. (3.) That none of the various eneric names that had been applied to this species were tenable, accord- ng to recognized rules of nomenclature. He then proceeds to show vhy the former generic appellations of *Meriones*, *Jaculus*, *Dipus*, and *Gerbillus* are inapplicable, and proposes the new one of *Zapus*, in allu- ion to its large hind feet. The adoption of this name for the genus he onsiders as necessitating the changing of the family name from *Jaculidæ* *Zapodidæ*. Then follows the generic and specific synonomy, amounting one and a half pages, the latter embracing more than a dozen specific ames, four of which have had, at different times, considerable prominence. etailed descriptions are also given of the cranial, dental, and external iaracters of the genus, with a notice of its geographical distribution, and marks on its synonymy.

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[1] *On the Muridæ of the Northern Boundary Survey, with a Critical Revision of the North American Genera and Species.* United States Northern Boundary Commission. Archibald Campbell, Esq., Commissioner. Major W. J. Twining, United States Engineers, Chief Astronomer. Natural History. No. 1. On the Muridæ. By ELLIOTT COUES, United States Army, Surgeon and Naturalist of the Commission. Reissued, with additions, from the Proceedings of the Academy of Natural Sciences of Philadelphia, 1874. Philadelphia. Collins, printer. 1874. 8vo, pp. 28.

[2] *Some Account, Critical, Descriptive, and Historical, of Zapus Hudsonius.* By DR. ELLIOTT COUES, United States Army. Bulletin of the United States Geological and Geographical Survey of the Territories. Second Series, No. 5, pp. 253–262, January 8, 1875. It was also reissued separately by the author, the separate copies bearing date 1875.

BRINTON'S MYTHS OF THE NEW WORLD.[1] — "Picking painfully nid the ruins of a race gone to wreck centuries ago, rejecting much reign rubbish and scrutinizing each stone that lies around, if we still e unable to rebuild the edifice in its pristine symmetry, yet we can at ast discern and trace the ground plan and outlines of the fane." This is hat the author has most successfully done, and the results of his studies e attractively embodied in the handsome volume before us. Freed om the false interpretations so frequently placed upon them, we have re given us what certainly can be accepted as a very correct idea of e mental condition and peculiarity of those strange tribes of men, the -called Indians of North and South America. Chapters II. to X. in- isive cover the fascinating field of study suggested by the ideas of God iong the Red race; Sacred Numbers, The Symbol of the Bird and rpent, Myths of Water, Fire, Thunder, and the Religion of Sex; also e subject of their Supreme Gods, The Myths of Creation, the Deluge, ature's Epochs and the Last Day. Chapters VIII. and IX. are devoted the subject of the origin of man and the soul and its destiny, as these xed questions of our day were looked upon by the Red men, and to are the most entertaining chapters of the work. The author traces ck the myths of the Red men generally back to the one solar myth, d disposes of the personality of their god-like heroes, as Quetzalcoatl, racocha, and Michabo.

The opening chapter, a general consideration of the Red race, is not, us, quite so satisfactory as the body of the work. While a most ex- lent *résumé* of the proofs of the antiquity of American man is given, such as his *isolation*, being "cut off time out of mind from the rest of the world," and the fact that "the remains of primeval art and the impress he made upon nature bespeak for man a residence in the New World coeval with the most distant events of history," the author, if we understand him aright, adopts the theory of the unity of the human race. If by unity is meant a common origin from one creative centre, and that a creation *de novo*, rather than derivative, then we dissent. Indeed, reasons are given in every chapter of the work, for believing that the Red race of America never had any intercourse, or bore any relationship to other peoples of any portion of the globe, unless we trace man back so far into time past that we see him the occupant of continents not now existing as such.. A word, and we have done. On page 35, Dr. Brinton states that "not a tittle of evidence is on record to carry the age of man in America beyond the present geological epoch." In this connection we would call attention to the remark of the late Professor Wyman, on page 45 of Fresh-Water Shell-Mounds of Florida, as follows: "The ancient remains found in California . . . by Professor J. D. Whitney, and referred by him to the tertiary period," etc., etc. To this is added an important foot-note, that "the ample evidence collected by Professor Whitney, but not yet published, substantiates the opinion given above with regard to age." We have, therefore, something more than a tittle of such evidence, and we are carried back to a time when man in America was even too primitive to originate those curious myths which afterwards became so marked a feature of their lives, and which Dr. Brinton has most successfully interpreted.

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[1] *The Myths of the New World.* A Treatise on the Symbolism and Mythology of Red Race of America. By D. G. BRINTON, A. M., M. D. Second Edition, ised. New York: Henry Holt & Co. 1876. $2.50.

RECENT BOOKS AND PAMPHLETS. — Prehistoric Man. Researches into the Origin of Civilization in the Old and New Worlds. By Daniel Wilson. Third edition, revised and enlarged, with illustrations. 2 vols. London: Macmillan & Co. 1876. 8vo, pp. 399, 401.

List of Skeletons and Crania in the Section of Comparative Anatomy of the United States Army Medical Museum, for Use during the International Exhibition of 1876, in Connection with the Representatives of the Medical Department, United States Army. Washington, D. C. 1876. 8vo, pp. 52.

An Account of the Worcester Lyceum and Natural History Association. By Nathaniel Paine. Prepared for the International Exhibition, 1876. Worcester. 1876. 8vo, pp. 13.

On some Characters of the Genus *Coryphodon* Owen. By Professor O. C. Marsh. 8vo, pp. 4. (From the American Journal of Science and Arts, vol. xi., May, 1876.)

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GENERAL NOTES.

BOTANY.[1]

ARRESTED GROWTH AND PERSISTENCE OF BARBULA RURALIS. — During a visit made to Ile Royale, Michigan (Lake Superior), in the summer of 1874, my attention was called to a curious example of the reservation of such a fragile organism as a moss, while what we regard s more enduring objects perish and disappear. At Scovill's Point, a harp, high tongue of rock, of trap formation, running out into the lake r several hundred feet, the almost level summit presents a large space ickly carpeted with the moss *Barbula ruralis* Hedw. In this were in-ribed a number of names and dates, made by simply cutting away the oss and letting the underlying rock appear. The inscriptions, mostly bold characters of several inches in length, were in general distinctly gible, the dark green (almost black) moss preserving the outlines, and ppearing, with few exceptions, to have remained at a stand-still — ither decaying nor growing — since the writings were made.

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[1] Conducted by PROF. G. L. GOODALE.

One of the most prominent names was that of the gentleman after hom the point is called. This has the date '46 attached to it; and a iend, a mutual acquaintance, who accompanied me and pointed out the ace, informed me that in the year denoted (twenty-eight years before), e gentleman, visiting Ile Royale, to his surprise, found inscriptions in e moss here, and added his name with the date. His son was with m at the time, and, revisiting the island in 1872, climbed up here to see ether any trace of his father's writing remained, and to his astonish-nt finding it as well as the other inscriptions undisturbed, cut his own me with the date — all in the Barbula. The isolated locality, and the ep (mostly perpendicular or overhanging) sides of the cliff, render it bable that few persons would find their way to the spot without some h object in view. The inscriptions, as seen by me in 1874, were as lows: "June — 1825." "— 43." "P. A. Scovill, '46." "— 47. — "O. C. Scovill — 1872."

The first of these inscriptions I have thought may have been made the party of Captain Bayfield, R. N., who about the date given made survey of Lake Superior, undoubtedly visiting this island. That it l the other older ones should be preserved for such a length of time in fragile a substance, is surely remarkable. From the time at which I them to the earliest date would cover a period of forty-nine years. d most interesting is the evidence here conveyed of the persistence of moss, coupled with its arrested growth. The plants were so dry and ttle as to be easily rubbed to powder between the hands, and could h difficulty be removed without breaking them. Yet on placing some water they revived so as to apparently present full vitality.

This is not the first time I have had my attention called to this plant its semi-torpid habit. It must be of exceedingly slow growth; and elieve it is but rarely found in fruit. Though it is abundant on Lake erior, I have never met a fertile specimen. — HENRY GILLMAN, roit, Michigan.

N THE HYGROSCOPIC MECHANISM BY WHICH CERTAIN SEEDS ARE BLED TO BURY THEMSELVES IN THE GROUND. — Mr. Francis win read an interesting paper on this subject at a recent meeting of the Linnean Society of London. The plant on which his observations were made was chiefly the feather-grass, *Stipa pennata*, but the same phenomena exist in many grasses, in *Anemone montana*, and in some of the Geraniaceæ. The essential points of structure common to all these self-burying seeds are: (1) a sharp point more or less covered with reflexed hairs; (2) a strong woody awn sharply bent at one point so as to be divided into a lower vertical and an upper more or less horizontal part, the vertical part being strongly twisted on its own axis (or forming a helix as in the Geraniaceæ). The hygroscopic phenomena exhibited by all the seeds are, (1.) On being wetted the vertical part of the awn untwists, and causes the straight horizontal part to revolve and describe a circle in a horizontal plane; the angle between the vertical and horizontal parts also gradually disappears, and the awn becomes straight. (2.) As the awn becomes dry again, the movements just described are reversed, the angular bend and the torsion of the lower part of the awn appearing. The process by which the seed of *Stipa* buries itself is as follows: the long feathery horizontal part of the awn is easily entangled in low vegetation, and the seed is thus held in a more or less vertical position, its point resting on the ground. When the awn becomes wet it tends to untwist, but the horizontal part being unable to revolve, the rotation is transferred to the seed; the tendency of the seed to straighten itself is also converted into pressure of the point of the seed against the soil. As the awn dries again, the seed is not pulled out of the ground, as would be the natural result of the reversal of the movements by which it was buried. On the contrary, it is actually thrust deeper into the soil during the process of drying. By the combination of these two alternate actions the seed is completely buried. What special advantage it may be to a plant that its seeds should be buried is uncertain; in the case of *Stipa*, at least, it seems to have no connection with germination; it is conjectured that it may serve as a protection against graminivorous birds, etc. The explanations given by Hildebrand of the twist in the awn of the wild oat, and by Hanstein of the torsion of the awn of *Erodium*, appear to be inadequate to explain the phenomena. The hygroscopic torsion of the awn appears really to depend on the power of torsion residing in the individual cells of which the awn is composed. Thus when an isolated cell is dried it twists on its own axis in precisely the same manner and direction as the awn itself; and just as the latter untwists in moisture, so do the individual cells in like condition. It is demonstrable that the torsion of the separate cells must cause the awn to twist as a whole. This remarkable power appears to depend on the molecular structure (stratification and striation) of the walls of the twisting cells. Although it was previously known from the researches of Nägeli and others, that certain cells become twisted in drying, yet their combination so as to produce torsion in a considerable mass of tissue has not before been observed. Neither

power of torsion in drying, possessed by the cells, been hitherto
o be of use in the economy of any plant. — A. W. BENNETT.

POTATO DISEASE. — The supposed discovery of the sexual re-
ive organs of *Peronospora infestans*, the fungus which causes the
light, by Mr. W. G. Smith, continues to attract much atten-
England and on the Continent of Europe. The eminent my-
, Professor De Bary, of Strasburg, does not altogether accept
ith's conclusions, believing that what he considers the resting-
of *Peronospora* must belong to some other fungus accidentally
in the decaying tissue; and his views were recently explained
Linnean Society of London by Mr. Carruthers, F. R. S. Pro-
De Bary proposes to divide the group Peronosporeæ into three
In *Cystopus* the conidiophores grow in large bunches, the conidia
eveloped in single rows in basipetal order. In *Peronospora*, from
ke mycelium, conidiophores arise singly or in small bunches at
s of the branches, and have no successors in the direct line. The
nus, *Phytophthora*, to which the old *Peronospora infestans* be-
iffers in its multiple and successive conidia, which, when shed,
wellings on the branches. In all three genera the ripe conidia,
laced in water, produce ciliated zoöspores, which penetrate the
f the host and develop threads or mycelium. By another and
mode of propagation the oögonia, bladder-shaped female cells,
ing fertilized by the small male cells or antheridia, produce from
rotoplasm a thick-walled oöspore, from which mycelial threads
and the process is then repeated. A considerable period of in-
may, however, precede the germination of the oospore, which
case hibernates during the winter, while its host decays. The
propagate and spread the fungus during the summer season only,
not live through the winter. Professor De Bary has found in
g potato-tubers bodies exactly corresponding to oogonia. On
nenting with the oöspores of these and planting them in potato-
he obtained minute bodies which conducted themselves precisely
öspores, and in most respects resembled those of *Pythium*. Other
nents with them, on the moistened legs of dead flies and bodies of
resulted in their complete phases of development which were
d step by step, the zoöspores producing a plentiful crop of myce-
tc. As this new fungus differs in many ways from *Phytophthora*
ns, De Bary proposes to call it *Pythium vexans*, and he regards it
nging to the Saprolegnieæ. The fungus named by Montagne
gus, and the warty bodies found associated with it he believes to
forms not connected genetically, and only imperfectly known.
likewise investigated the question of the perennial mycelium of
hthora occasionally hibernating where the oöspores are not found in
trict, and believes that he has proved that there are two methods
h the conidia may pass from the tuber to the foliage. — A. W. B.

APLECTRUM WITH CORAL-LIKE ROOT. — Early in April, 1876, in transplanting some *Aplectrum hyemale* Nutt., from the woods northwest of Detroit, I found two adjoining plants of this species having branched and toothed coral-like roots, similar to those of *Corallorhiza*, immediately beneath the usual bulb or corm, which was also provided with the ordinary rootlets. Each plant had the green leaf which the species sends up in autumn. A close examination of forty-three additional plants from the same woods failed to discover another instance of this interesting and significant peculiarity. I have transplanted from this place, at various seasons, during eleven years over one hundred specimens of this plant; but never before found a case like the above-described. The coral-like roots seemed parasitic on the partly decayed bark of a tree-root, and the whole was imbedded in ice, the frost still being in the ground. The absence of the coral-like root has been made a generic distinction separating *Aplectrum* from *Corallorhiza*.

I have sent the specimens to Professor Gray, who previously had never seen nor heard of this "unexpected fact." I request of botanists throughout the parts of the country where this plant is found, to search for the peculiarity, that we may learn whether it exists elsewhere, and to what extent; though, from my own experience, I think it likely to prove most exceptional. — HENRY GILLMAN, Detroit, Michigan.

RESEARCHES IN REGARD TO GROWTH. — The method pursued by Reinke appears to be a modification of that employed in the laboratory at Würzburg, and for which he does not give the credit due. The improvement in the apparatus .seems to be a real one. A balanced and therefore tight thread goes from the growing plant over a wheel, which by index and multiplier enables the observer to watch and record the growth. A microscope of long focus is used to read the vernier. A notice of the results obtained by the use of this apparatus must be deferred.

RHYNCHOSPORA CAPILLACEA VAR. LEVISETA. — This is named and was discovered by the Rev. E. G. Hill, and is characterized by having the perianth bristles *perfectly smooth*, while in the ordinary form they are downwardly denticulate-roughened. Except in this remarkable particular the plant appears to be undistinguishable from *R. capillacea*. Mr. Hill found the plant in wet pine barrens, around the head of Lake Michigan, at Pine Station, Indiana. There is another variety, hardly needing a name (at least until it is confirmed by finding it constant, and in other stations), discovered in Herkimer County, New York, in 1864, by Professor J. A. Paine, which has twelve bristles (instead of the ordinary six), and the remarkable stipe to the akene is rather shorter than usual. — A. GRAY.

AN HERBARIUM FOR SALE. — An herbarium containing specimens illustrating six thousand species of plants is offered for sale. Full particulars can be obtained from President Chadbourne, of Williams College, Williamstown, Mass.

Botanical Papers in Recent Periodicals. — *Comptes rendus*,
o. 9. Boussingault, On the Influence exerted by Vegetable Mold on
e Nitrification of Nitrogenized Substances used as Manures. S.
oëz, On Elæococca Oil, and its Modification by Light. Ed. Heckel,
the Movements of the Hairs and Glands of the Leaves of *Drosera*
tundifolia, and in the Leaves of *Pinguicula vulgaris*. No. 10. A.
rthélemy, On the Absorption by Plants of Bicarbonates in Natural
aters.

Flora, No. 5 and continued in No. 6. Dr. H. Müller, On Heliotrop-
n. (The following conclusions are reached: (1.) In a growing organ
a plant only those zones which have not yet finished growing, exhibit
rvatures dependent on light. (2.) The heliotropic curvature is pro-
ced by *all* the sensitive zones during extension. (3.) The parts which
w most rapidly are most sensitive to light. (4.) Even negative
iotropism (curvatures away from the light) as in roots is most marked
en growth is most vigorous. (5.) Heliotropic curvatures do not cease
once when the light is removed. (6.) The rate of the curving is slow
first, then is accelerated, reaches a maximum, after which it dimin-
es. (7.) The curvature is not always at the same place; it recedes
dually towards the lower end of the growing stem. (8.) The
ller the angle which the incident rays of light make with the axis
the stem, the slighter will be the effect produced. (9.) Heliotropism
tinues until growth ceases or until light has been brought to act upon
sides of the plant, or until the curvature from light is overpowered
curvature from gravitation (geotropism). (10.) Heliotropic curva-
, under similar circumstances, increased with intensity of light. (11.)
ns which have been previously kept in the dark are more sensitive
ight coming from one side, than are those which have been previously
minated on all sides. (12.) The concave side, which is the one most
ly illuminated, grows less rapidly than the other. (13.) Negative
atures are not accompanied by uniform growth throughout all zones
are characterized by growth only in the lower zone. (14.) Helio-
ic curvatures are more rapid when geotropism is excluded. (15.)
tropism counteracts heliotropism, to differing degrees in different
ts. (16.) Certain parts or stems are sensitive to light, and others
highly geotropic. (17.) Some negatively heliotropic roots are hin-
d in growth when they are illuminated on all sides.) X. Landerer,
thens, Botanical Notes from Greece. No. 7 and 8. Hugo de Vries,
Wood Repairing Wounds (continued). J. Sachs, On Reinke's In-
gations respecting Growth. (Alleging that what Reinke has lately
ished in regard to a new instrument for measuring rate of growth
resses the fact that the method used is substantially that employed
achs.) A. Geheeb (noticing mosses from near the Rhone).

tanische Zeitung, No. 11. Ph. Van Tieghem, New Observations
ecting the Development of the Fruit and the supposed Sexuality

of *Basidiomycetes* and *Ascomycetes.* (Noticing Brefeld's paper, and claiming that Brefeld has substantially *confirmed* the results of Van Tieghem's early researches.) Max Reess, A Correction (of an alleged error in Brefeld's memoir). Reinke, Investigations Respecting Growth. No. 12. Dodel-Port, Concerning the Swarm-spores of *Ulothrix zonata.* Reports of Societies: Amsterdam, Jonkman, On the Prothallium of *Marattiaceæ.* No. 13. Th. Irmisch, A Contribution to the Natural History of *Cactaceæ.* (Considering the seedlings of *Rhipsalis.*) No. 14. In Reports of Societies: Gottingen. Holle, On the Organs of Vegetation in *Marattiaceæ.* Holle, On a New Camera (using a double mirror).

ZOÖLOGY.

THE EUROPEAN WOODCOCK SHOT IN VIRGINIA. — A few days ago I received from Dr. M. G. Ellzey, of Blacksburg, Va., the information that "a European woodcock was shot in Loudon County, in November, 1873," by his brother, with a number of the common species these gentlemen secured together. The alleged occurrence being one of much interest, I wrote, asking for further particulars, in order to secure the "internal" evidence necessary to place the matter beyond question. Dr. Ellzey appears to be perfectly competent in the case, from the particularity of the reply with which he has favored me. "The flight of the bird was slower, heavier, and nearer the ground than that of the familiar bird. When compared with twelve or fifteen of the latter, it appeared at least twice as large as the largest of them; the wing was longer, more pointed, and possessed but one falcate primary. The bird was found to weigh fourteen and one half ounces; it seems to me that this weight alone is sufficient to determine the species, the heaviest American woodcock ever weighed by me being only seven and one half ounces, while the average is about five and one half. Moreover, the character of the wing settles the matter beyond dispute. I was at the time aware of the peculiarities of the European bird as compared with ours in this respect, and made the comparison with such care as to preclude possibility of mistake. I had not at the time, nor have I since had, the smallest doubt of the correctness of my diagnosis. The bird was not preserved, as I wished, to be sent to a taxidermist for mounting, but was cooked and eaten with the rest."

We have several authentic records of the casual presence of *Scolopax rusticola* in America, besides some less explicit references to the same fact in the works of leading sporting writers; but so far as I now remember, there has hitherto been no recorded instance of the occurrence of the species south of New Jersey. — ELLIOTT COUES.

NOTABLE CHANGE OF HABIT OF THE BANK SWALLOW. — In treating of this bird (*Cotyle riparia*, Birds of the Northwest, p. 87), I state, "It becomes an interesting question whether the bank swallow will ever abandon its burrows, and so far modify its fossorial nature as to

ild in chinks and crannies, or affix a nest anywhere about a building."
he matter is already decided, and the surmise verified, as I learn from
correspondent, Dr. Rufus Haymond, well known by his contributions
the ornithology of Indiana. He writes as follows: "The depot of the
hite Water Valley Railway, in Brookville, Indiana, is built upon
ne piers, and spans the hydraulic canal, some five or six feet above the
ter. While at the depot during the past summer I saw a bank swal-
r fly under the building with several blades of grass in her bill; and
ing curious to see what she would do with them, I watched her, and
r her carry them through a two-inch auger hole which had been bored
ough a pine board. The spot was inaccessible, owing to the water;
t I know from the droppings about the hole that this was her nest."
ave never seen or heard of any previous record of such habit, and
sider Dr. Haymond's statements very interesting. — ELLIOTT COUES.

THE CHAPPARAL COCK. — Can any of your ornithological readers
e us any information as to the food of the chapparal cock, or road
nner, as it is usually called in this region (*Geococcyx Californianus*).
s found, though it is not abundant, along the foot-hills in this vicinity.
riend gave me a specimen killed here a few days ago, but I believe it
ot found north of the "Divide." On mounting the bird I found in its
zard no recognizable matter except *débris* of grasshoppers, and as no
has seen a grasshopper alive here for two months, the question is,
ere did the bird get them? Does it provide its food in the season,
ng it up for winter? One of the grasshoppers was in perfect condi-
, except that it had lost some of its legs. Under a lens the mass of
comminuted material was seen to consist of minute pieces of legs and
gument of grasshoppers. — V. T. CHAMBERS, Colorado Springs,
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HE "SISCO OF LAKE TIPPECANOE." — I am informed by Mr. J. A.
shall of Oconomowoc, Wis., that the fish described by me under the
ve name (*Argyrosomus sisco*, AMERICAN NATURALIST, March, 1875,
35) occurs in abundance in Nemahbin Lake, Waukesha County,
., which empties into Rock River, through Bark River, and in Okau-
, Oconomowoc, and La Belle lakes, in the same county, which send
r waters also to Rock River by way of the Oconomowoc.

notice of this species occurs in Rafinesque's Ichthyologia Ohiensis,
4, as follows: —

The white fish of Lake Erie, *Coregonus albus* of Le Sueur (or
no clupeiformis of Dr. Mitchell), a fish which differs from the trouts
eing toothless, is said to be found in some streams of Indiana at the
of the Wabash and Miami; but I have no certain proof of this." —
. JORDAN.

RALS AND CORAL ISLANDS; BY JAMES D. DANA. — We are not
g to review the book, as it is one which we suppose a large part of
eaders are familiar with already. We only propose that they shall

share with us the amusement we had in reading a review of it in the *British Quarterly* for October last. Here is a sentence: "Professor Dana, who is another Hugh Miller, made his mark as a writer many years ago by his Two Years before the Mast. The man who could write that was clearly marked out for something better than the life of an able-bodied seaman; but few who have risen in life as he has have been able to turn to such use the lessons of sea-faring life learned in earlier years."

"The man who could write that" precious sentence in a quarterly review, confuse two men of such mark, and educe either of them from an illiterate sailor, has earned thereby a word of notice.

NOTE ON THE BLUE GOOSE. — A few years ago I came upon a flock of four *Anser cærulescens*, about two miles west of this place, in April. They were feeding upon a grass-plot upon the bank of the west fork of White Water River. As I approached them, and before I discovered them, they rose up from the ground very much in the manner of the mallard. I shot one some days later, breaking its wing, and brought it home with the hope of saving it, but it died in a few hours. One of the three left was afterwards shot by one of my neighbors, Mr. Halstead, with a rifle. The wing was shot off at the wrist joint. He secured the goose, took it home, fed it, and it became as tame as a domestic goose. He lived near the bank of the river, but, notwithstanding he had tame geese with which it associated, it would never approach the water, but would stand upon an elevation and watch those in the river. He kept it a year, from April to April, but a hurricane which occurred in the last April blew a fence down upon it and killed it. I saw it in the fall after he caught it. It ate corn very greedily, but, unlike the common goose, did not swallow the corn whole, but picked up every grain, placed it between the outer edges of the bill and bit it in two, the bill snapping like a steel-trap. This, to me, was a curious fact, but the fact that for a whole year it never entered the water was still more astonishing. — RUFUS HAYMOND, Brookeville, Indiana.

OCCURRENCE OF MAGGOTS IN A BOY. — Dr. G. W. Martin, a homœopathic physician, and a very intelligent, well-informed gentleman, was recently (June 5th) called to see a patient, a lad of about fourteen years, who had been seized with violent spasms. The doctor gave as an assistant remedy a purgative, whereupon the lad passed at one stool about fifty little insects or bugs, as he called them. The doctor brought them to me and I told him that they were dipterous larvæ. I requested him to put some in a box of moist earth covered with glass, and the flies appeared on the 17th of June. Now can you tell what the fly is? — GILBERT S. JUDD, Maysville, Ky., June 22, 1875.

[On submitting the flies to Baron Osten Sacken, he wrote us as follows: "The fly you gave me is *Anthomyia* (Homalomyia) *scalaris*, one of those mentioned in the *American Entomologist*, ii. 139, and of rhich similar experience is recorded in Europe." The article referred ɔ is entitled Larvæ in the Human Bowels. It is by the late Mr. Valsh, and gives a good summary of what is known of the subject in his country. See also Guide to the Study of Insects, pp. 366, 367. – Ed. Naturalist.]

Swedish Podurans. — The *Poduridæ*, or "spring-tails" of Sweden, ave been monographed in an elaborate way by T. Tullberg. The mem- ir is accompanied by twelve plates, and enters quite fully into the natomy of these little creatures of so much interest to microscopists. he work appears in the Transactions of the Royal Swedish Academy r 1871, and has just reached this country.

ANTHROPOLOGY.

An Interesting "Find" of Indian Relics. — A very interesting find" of Indian relics has been obtained by the writer, from a locality ot previously examined, although within a short distance of the site of s collecting labors of the past three years. By the uprooting of a large ee during the tornado of Tuesday night, February 1st, and a consequent ndslide on the south bank of Crosswick's Creek, near Yardville, Mer- r County, New Jersey, the traces of the site of a former "homestead" ere brought to light, consisting of corn-mills, pestles, axes, hammers, ears, and arrow-points, associated with innumerable fragments of nes, mussel-shells, and charcoal. No fragments of the bones were suf- iently large to determine the animals to which they belonged, beyond fact that while some undoubtedly were fragments of mammal bones, vast majority were those of birds and large fishes. The main feature interest connected with the stone implements is the uniform character the workmanship displayed in their manufacture. There was not nd one polished celt, or a single specimen of jasper arrowhead. The d consists of the following specimens: Sixteen arrow-points varying m four inches to one and one half in length; they are all of the same neral, a slaty rock, and now very much weather-worn, soft, and plia- . One spear-head, six inches in length, made of the same mineral and ally weather-worn. Five specimens varying between the spear and fe forms, one of white quartz, and all of the same character of work- nship. One specimen of an elongate, lozenge-shaped implement, en inches in length by two in greatest width, and pointed at each end; edges have been chipped; very much weather-worn. These twenty- ee specimens, found as they were together, bear us out in our remarks the February number of the Naturalist, that specimens found p in the soil, as a class, are less elaborately wrought than those nd nearer the surface. They were lying, when exposed to view, about feet below the surface, and the character of the soil is such that its umulation is wholly due, I believe, to the gradual decomposition of etable matter, commingled with fine sand, such as gentle winds will carry as "dust." If, as was suggested in the February number of this journal, one inch of soil will accumulate in one hundred and twenty-eight years, these specimens are fully thirty centuries old, and certainly their general appearance is suggestive of as considerable an antiquity.

The large specimens that were taken from the mingled dust and ashes of this ancient dwelling-place comprise two corn-mills, as they are usually called. They are both large, quadrangular, sandstone bowlders, one with the depression only on one side, the other with a shallow cup on each side. With them was one globular pebble three and one half inches in diameter, that evidently had been used as the crusher, in reducing the corn or nuts to a powder. The grooved stone axes were thirteen in number, varying somewhat in pattern, but particularly noticeable in that but two were of that form in which the groove does not extend entirely around the head of the ax, but leaves a smooth surface on the upper edge.[1] This pattern may be of later date than those with the groove extending entirely around the specimen. I have found, on comparing many hundreds of these relics, that as a rule those with the groove not encircling the implement are more accurately finished, and with a greater extent of polished surface. Pebbles of a very regular outline were chosen, and the variation among them was in size only. On the other hand, pebbles not at all symmetrical were frequently chosen for axes, grooved and ground to an edge at one end; but such non-symmetrical specimens, I believe, always have the groove extending entirely about them. The thirteen specimens here mentioned vary from eight to four inches in length. The workmanship displayed in their production quite accords with the rude arrow and spear points with which they were associated. Not one can be called a first-class ax, although some certainly are better finished than others. There occurred two specimens of chipped clay-slate implements, that approach the ax in form, and which were evidently designed as cutting implements. One is quadrangular, six inches in length by four in width, and about one inch in thickness. The chipping is easily traced over the entire surface. There is no trace of a polished edge or groove. A slight depression on the upper and lower margins indicate that a handle was once attached to the specimen, as ordinary grooved axes were hafted. The accompanying specimen is still ruder in finish, but has a better-wrought edge. It is obtusely triangular in outline, and a little shorter and narrower than the preceding. The pestles are eight in number and vary from one foot to four inches in length. None are polished and worked into an accurately cylindrical shape, and the larger ones all have the heads so battered as to show that they were used as we use modern pestles in mortars, and not as "rollers," or war-clubs, as some have suggested. The other specimens, eight in number, consist of two net-sinkers, two hammer-stones, a scraper, and three cobble-stones, two of which have been somewhat chipped, as though intended one for an ax, the other for a chisel or gouge. The other is a curiously shaped stone, that has been utilized as a hammer or nut-cracker. The shape may be designed and not accidental. It is quite certain that the aborigines made use of stones of convenient shapes, for many of the simpler household purposes; but it does not follow because no trace of chipping or polishing is to be detected upon these stones, that the stone has been accidentally so shaped, for the long-continued use of a broken stone would tend to wear it down and so obliterate the trace of the fracture. A survey of the fifty-four specimens constituting this "find," together with the circumstances under which they were discovered, afford, I think, valuable additional evidence of the facts, as I believe them to be, with reference to the stone implements found in North America generally, which are that those found most deeply embedded are the older, and that there is abundant reason for considering that during the occupancy of the Atlantic coast of North America, the Indians advanced from a lower to a higher stage of stone-age culture. — CHARLES C. ABBOTT, M. D.

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[1] The American Naturalist, vi. 145, Figure 10.

ANTHROPOLOGICAL NEWS. — Colonel Charles Whittlesey contributes to the *Scientific Monthly* of Toledo, for November, 1875, articles on he Rock Inscriptions in Amherst, Lorain County, Ohio, and on The Comparison of the Indians and Mound Builders.

A story has been going the rounds of the papers to the effect that pygmy graves exist in Tennessee and Kentucky. It is not new, Haywood in his Natural and Aboriginal History of Tennessee having atempted to substantiate the notion. The following evidence that no pygmy race left their remains in this part of our country must be concluive. Mr. S. E. Haskin, writing from Pine Falls, Tennessee, after having opened twenty small slab-graves in White County, says that the graves vary in length from fifteen inches to two feet, and in width from even to fourteen inches. He sends with his letter a package of bones nd teeth. Some of the latter are milk teeth, and in one fragment of a aw-bone the second teeth are pushing out behind the milk teeth. Mr. W. M. Clark, employed during the last year by the Smithsonian Instituon, to investigate the same subject, and who sent the relics mentioned y Bessels in his paper in the Bulletin of Hayden's Geological Survey, Vol. II., No. 1), has written for the Smithsonian Report for 1875 a long ccount of his labors, in which he distinctly proves that the little slab-graves are either those of children or are ossuaries. But the most exhaustive refutation of the whole matter is contained in Chapter II. of a aper, accepted for publication in a forthcoming volume of the Smithonian Contributions to Knowledge, by Dr. Joseph Jones, of New Orleans. he entire subject is reviewed, from Haywood's work down, and the ost convincing proof brought forward from the examination of hundreds graves, that the small cists are either children's graves or ossuaries. the former case the fragile jaw exhibits two sets of teeth; in the latter case parts of more than one skeleton are found. Furthermore, in the same mound with the so-called pygmy graves are found long graves in which the skeletons of unusually tall men and women lie at full length.

The International Congress of Americanists will hold its next session at Luxemburg, from the 10th to the 13th of September, 1877. They have already issued their circular of invitation.

Mr. Charles M. Wallace contributes to the *American Journal of Science* for March an article in which he claims to have found in the beds of brick, clay, and stratified gravels, near Richmond, Va., various hatchet-like, disk-like, and spear-shaped palæolithic implements, from four to eight feet below the surface. "One of them is somewhat like an implement from the Reculver Pits" (Evans, p. 534, N. Y., 1872). The name of Professor Baird is used in the article as *encouraging* the author (he encourages every diligent seeker for truth); but I am sure Mr. Wallace does not mean to say that Professor Baird *endorsed* his conclusions as to the nature of his finds. Two things are necessary to be done in the case. The most scrupulous care is to be exercised in determining exactly all the conditions of the find, and the implements must be compared with similar ones from other localities by skilled archæologists before any safe conclusion can be reached.

The Paris Anthropological Society has issued separately the craniological and craniometrical instructions, prepared by a committee of that body.

Both the January and the February numbers of *Matériaux pour l'Histoire primitive et naturelle de l'Homme* are full of interesting matter. All lovers of archæology should encourage this periodical, whose editors, at great personal sacrifice, conduct it solely in the interest of science.

The Rev. William Houghton read a paper before the Society of Biblical Archæology, March 7th, on the Mammalia of the Assyrian Monuments; Part I., Domestic Mammals. There are three forms of representation: (1) by pictorial or sculptural representations; (2) by description; (3) by picture and description combined. The domestic animals known were the ox, sheep, goat, camel, ass, horse, mule, and dog. The author promised a subsequent paper on the Wild Animals.

George Smith writes to the *Athenæum* of February 12th, "I have discovered a Babylonian text giving a remarkable account of the temple of Belus at Babylon. It is the first time any detailed description of a temple has been found in the cuneiform texts."

Mr. E. B. Tylor read before the London Institution, March 23, 1876, a paper on the Races of Mankind and Their Civilization. The following works on anthropology have appeared: Hellwald, Culturgeschichte; reviewed by Tylor in *Academy*, February 26th. Wilson, Prehistoric Man, 2 vols., Macmillan. Gill, Myths and Songs of the South Pacific, King & Co., London. Koner, Bibliography of Anthropology. Garland, Atlas der Ethnographie, Leipzig, Brockhaus.

GEOLOGY AND PALÆONTOLOGY.

The Tæniodonta, a New Group of Eocene Mammals. — At a recent meeting of the Academy of Natural Sciences of Philadelphia, Professor Cope described the character of some mammalia from the Eocene deposits of New Mexico, obtained by him during the Wheeler Expedition of 1874, which he regarded as allied to the *Insectivora*. The feet are armed with compressed claws. The dental characters are seen first in the supposed superior incisors. Unfortunately they have not yet been found in place in the cranium, but their association with a rodent type of inferior incisors, which have been found in place in the mandible, confines us to the alternative choice between superior incisors and canines. From the small size or absence of inferior canines a similar character may be inferred for the superior canines.

The superior incisors present two bands of enamel, an anterior and a posterior. They are compressed in form, the sides presenting a surface of dentine or cementum. Attrition produces a truncate or slightly concave extremity. The inferior incisors are rodent-like.

Two families represented this suborder in the Eocene period in New Mexico. The first, or *Ectoganidæ*, possessed molar teeth with several oots; in the *Calamodontidæ*, each molar has a simple conic fang. But ne genus of each family is known. In both the enamel of the molars s principally a band on the outer side of the crown; the deficiency is upplied in *Calamodon* by a deposit of cementum which invests the molar and superior incisor teeth, covering the crowns excepting where he enamel bands are present. The latter investment is so much thinner hat the cementum forms a raised border all round at the point of junc-on of the two substances. The general structure of *Calamodon* affords ome points of approximation to the *Edentata*, which indicate that the *Tæniodonta* partially fill the interval between that order and the *Eden-ta* presented by the existing fauna.

Professor Cope also pointed out the close resemblance between the andibular dentition of the contemporary Eocene genus *Esthonyx* and e existing *Erinaceus*, and stated that *Anchippodus* and allies chiefly ffer from *Esthonyx* in the persistent growth of the incisor teeth.[1]

GEOGRAPHY AND EXPLORATION.

Peruvian Geography. — The publication of the preliminary volume Don Antonio Raimondi's great work, El Peru, will be, says a writer in e *Geographical Magazine*, an epoch in the history of Peruvian geo-raphical research. This accomplished and indefatigable geographer d naturalist had traveled over every part of the republic, on a fixed an, during a space of nineteen years, diligently collecting materials before he sat down to prepare his great scientific work on Peru for publication. This first volume is the key to the whole work, for it describes the methods and instruments used in the various branches of science, and contains a most interesting personal narrative of the author's numerous journeys, during nineteen years, over the length and breadth of the land. The work itself will consist of six parts. The first will be devoted to geography and meteorology, the second to geology, the third to mineralogy, the fourth and fifth parts to botany and zoölogy, and the sixth and last to ethnology, including descriptions of the architectural remains, pottery, arms, etc., of the different Peruvian tribes.

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[1] See On the Supposed Carnivora of the Eocene of the Rocky Mountains, Proceed-gs of the Philadelphia Academy of Natural Sciences, December, 1875.

RECENT RISE OF THE PERUVIAN COAST. — Interesting illustrations of the comparatively recent change in the coast level of Peru and the geographical changes resulting, are afforded by Mr. A. Agassiz in the last Bulletin of the Museum of Comparative Zoölogy. A number of corals were found by him at the height of from 2900 to 3000 feet above the level of the sea, at a distance in a straight line from the Pacific Ocean of twenty miles. From the general features of the country along the coast of Peru, it requires but little imagination to reconstruct the former internal sea formed by the Coast Range, which must have, within comparatively recent geological times, covered the whole of the great nitrate basin of Peru, and which has gradually been elevated to its present position. This inland sea then became a salt lake, afterwards a lagoon, and finally was entirely drained. While Darwin showed that beyond doubt the coast of South America has been recently elevated 800 feet, Mr. Agassiz believes that the elevation reached an altitude of at least 2900 feet, and in earlier times, judging by the marine nature of the fauna of Lake Titicaca, to an elevation of 12,500 feet.

MICROSCOPY.[1]

THE LIMITS OF MICROSCOPIC VISION. — In his recent annual address to the Microscopical Society of London, the president, Mr. H. C. Sorby, F. R. S., discusses the relation between the limits of the powers of the microscope and the size of the ultimate molecules of matter. As the combined result of observation and theory, he concludes that the normal limit of distinct visibility with the most perfect microscope is one half of the wave-length of the light. If so, even with the very best lenses (except under special conditions) light itself is of too coarse a nature to even enable us to define objects less than $\frac{1}{80000}$ to $\frac{1}{100000}$ of an inch apart. It would appear, therefore, that as far as this question is concerned, our microscopes have already reached their ultimate limit. Adopting the results as to the size of the ultimate molecules of matter arrived at by Mr. Stanley, Sir W. Thomson, and Professor Clerk-Maxwell, Mr. Sorby calculates that in the smallest interval which could be distinctly seen by the best possible microscope, there would be about two thousand molecules of liquid water or about five hundred and twenty of albumen lying end to end; and that in order to see the ultimate constitution of organic bodies, we should requre a magnifying power from five hundred to two thousand times greater than those we now possess. He calculates that with our highest powers we are as far from seeing the ultimate molecules of organic substances as we should be from seeing the contents of a newspaper with the naked eye at the distance of a third of a mile. A spherical particle one tenth the diameter of the smallest speck that could be already defined with our best and highest powers, might nevertheless contain no less than one million structural molecules. Mr. Sorby makes a very interesting application of his results to Mr. Darwin's theory of pangenesis, his general conclusion being that no serious objection can be raised against the theory when examined from a purely physical point of view, as far as relates to the inheritance of a very complex variety of characters by the first generation. — A. W. BENNETT.

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[1] This department is conducted by DR. R. H. WARD, Troy, N. Y.

BOSTON MICROSCOPICAL SOCIETY. — This society held a public reeption at Fraternity Hall, on the evening of April 27th, for the purpose of making better known its organization and aims. A short exhibition with the oxy-hydrogen microscope was given, in addition to the se of more than fifty table microscopes, with their accessory apparatus.

EXCHANGES. — [Notices, not exceeding four lines in length, of microcopical objects or apparatus wanted or offered in exchange, not sale, vill be inserted in this column without expense.]

Arranged diatoms in exchange for good objects. Address offers to hristian Febiger, Wilmington, Del.

Extract of hop, mounted, showing lupulin crystals; in exchange for ny mounted objects. Address Richard Allen, 146 North Fourth Street, roy, N. Y.

SCIENTIFIC NEWS.

— Physicians will be interested in a work entitled Micro-Photographs Histology, Normal and Pathological, by Carl Seiler, in conjunction ith J. Gibbons Hunt, M. D., and J. G. Richardson, M. D., to be pubshed in twelve number by J. H. Coates, of Philadelphia.

— At a late meeting of the Paris Geographical Society, Dr. Haney ated that a cavern containing numerous Caraïb remains had been disvered at the western extremity of Cuba, and that these proved that the hole of the island was at one time inhabited by that race.

— Professor Marsh publishes in the *American Journal of Science*, for ne, a Notice of a New Suborder of Pterosauria. The group is distinished by the want of teeth.

— Mr. A. R. Marvine, a geologist of much promise, has recently died. e was at the time of his death attached to Professor Hayden's Survey.

— The Smithsonian collections for the International Exhibition have been forwarded to Philadelphia from Washington. They are designed to illustrate the resources of sea and shore, of the chase and fisheries, in the United States. Specimens of all the animals in this country will be exhibited, and all the machinery of hunting and trapping will receive the amplest illustration. It is stated that there are forty-five hundred casts of food fishes now at the Smithsonian ready to be sent. The casts are made of plaster and papier mache, modeled from frozen specimens and from photographs. Among the other objects there will be a running screen of the size of eighteen hundred square feet, filled with photographs of American food fishes. The dresses of the fishermen in various climates, the varieties of flies used in catching trout, the fishing rod, the harpoon, and the lance, will all be shown. The chase of the whale will be fully explained by the plainest object lessons, and among the treasures is a cast showing the capture of a whale. The exhibition of furs will be one of the most remarkable ever seen on the continent. The useful products of our inland and foreign waters (other than vertebrates), have been arranged by Dr. Dall. Among these will be shellfish, crabs, shrimps, corals, star-fish, sponges, and marine products not of an animal nature. Specimens of rare American animals and reptiles, and a group of lay figures intended to convey an idea of the character and habits of the North American Indians, will complete a very excellent collection.

PROCEEDINGS OF SOCIETIES.

National Academy of Sciences, Washington. — April 18–20. Professor Henry opened the public session by delivering the annual report which serves as a review of the year. It was confined to the official affairs of the Academy. The report of this year contains a touching allusion to the loss the Academy has sustained in the death of Prof. Joseph Winlock. the astronomer of Cambridge, Mass. Among the most prominent of the supporters of the Academy who have been called away by death during the past year was Vice-President Henry Wilson, who, although not a member, was one of the founders. He took a chief share in the preparation of the bill under which the Academy was organized, and urged its passage through Congress. Reviewing the present condition of the Academy, Professor Henry remarked that the plan by which its headquarters were fixed at Washington presented some inconvenience as a centre in comparison with larger cities; but there is no other place in the Union which contains so large a proportion of scientific men to its inhabitants, and the local society devoted to science is among the most prominent in the land. The establishment of the Johns Hopkins University at Baltimore, is now certain also to concentrate at no great distance from Washington a considerable band of prominent men of science.

There is also good reason to hope that means will be found to defray the expenses of non-resident members in traveling to and from the meetings.

The Academy, Professor Henry said, is becoming in a certain sense a
leader of public opinion in respect to the expression of calm judgment
and weight of scientific authority. This was its appropriate position.
The recent instances in which the government has sought its aid were
then briefly mentioned: its judgment had been required in respect to
nicroscopic determination (with reference to collecting duties) of the
roportions of wool imported in invoices of calves' hair; and it was
stimated that a million of dollars would be saved to the revenue in con-
equence. Still more recently investigations had been ordered to ascer-
ain the value of certain applications to the paper used in preparing
ractional currency; and as to the crystallization of different grades of
ugar, as a means for classifying them. The direction of the scientific
art of the Polaris expedition was intrusted to the Academy. Dr. Emil
Bessels has been engaged in preparing the material obtained for publica-
on. Three volumes are nearly complete. They will contain the re-
ults in the departments of hydrography, meteorology, and astronomy.
fourth volume is in preparation, of which Admiral Davis has charge;
is will contain the narrative of the expedition and much biographical
formation; its expense is borne by the Navy Department. The legacy
ft by Alexander Dallas Bache to the Academy has been applied, (1) to
e preparation of a magnetic survey of the United States; (2) to ob-
rvations on sun-spots, conducted at Cambridge, Mass.; (3) to certain
searches on light and heat. The first of these undertakings is in a
ndition to report considerable progress. The map when completed
ill prove of important service for surveying purposes and topography
nerally, as it will determine the dip and direction of the needle for all
calities. By the record of these data now, the students of the earth's
gnetism will have a means in future years to ascertain the rate and laws
the great secular variations, as yet only imperfectly understood. The
servations on the sun were conducted by the late Professor Winlock;
ce his death some arrangements have been projected for collating his
rk and continuing it. The researches on light and heat are carried
by Charles Peirce, a son of Prof. Benjamin Peirce. Part of the
gular work of the Academy consists in having memoirs prepared of its
ceased members, and the results of this work were stated.

The following papers were read: The Character of the Eocene Fauna
New Mexico, by E. D. Cope; A Conjectural Restoration of a Pueblo
the Mound Builders, by Lewis H. Morgan (in which he took the
und that the Mound Builders were village Indians who had migrated
n the tropics, and that the mounds were the building-sites of their
ement-houses); The Geology of Petroleum, by J. S. Newberry; The
ological Evidence on the Question of the Cause of the Cold of the
Period, J. S. Newberry; The Geological Structure and Topographi-
Aspects of the Catskill Mountains, by James Hall; The Geological

and Physical Structure of the Black Hills, by Henry Newton; The Age of Mountains as determined by Degradation, by J. W. Powell.

Five members were elected, namely, Professors Langley, Peters, and Haldeman, General Warren, and Mr. Clarence King.

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SCIENTIFIC SERIALS.[1]

THE ANNALS AND MAGAZINE OF NATURAL HISTORY. — April. Is there such a Thing as *Eozoön Canadense?* a Micro-Geological Investigation, by Otto Hahn. Descriptions of some New Species of Annelida from Kerguelen's Island, by W. C. McIntosh. Extinct Lemurina, by W. H. Flower. Note on the Embryogeny of *Salmacina Dysteri*, by A. Giard.

ARCHIVES DE ZOÖLOGIE EXPÉRIMENTALE ET GÉNÉRALE. — No. 4, 1875. Contributions à l'Histoire des Grégarines des Invertébres de Paris et de Roscoff, par A. Schneider. Recherches sur l'Appareil Circulatoire des Oursins [Echinus], par E. Perrier.

ZEITSCHRIFT FÜR WISSENSCHAFTLICHE ZOÖLOGIE (Siebold und Kölliker). — March 6. Researches on Free-Living Nematodes, and the Genus *Chætonotus*, by O. Bütschli. On the Ontogony of Cyclas, and the Homology of the Germ-Layers in the Mollusks, by H. von Ohering. On the Silk-Glands of Lepidoptera, by F. E. Helm. On the Formation of the Blastoderm in the Spiders, by H. Ludwig. On the Challenger Expedition. Letter to Professor Siebold, by R. V. Willemoes-Suhm.

PETERMANN'S MITTHEILUNGEN. — January 21st. The Ground Work of the Map of the Loango Coast, by P. Güssfeldt. The Geographical Convention in Paris, July 15 till September 16, 1875. The Southern Batta-Land of Sumatra, by A. Schreiber. Geographical Necrology of the year 1875. Journey to Araguay, by Dr. Couto de Magalhães, in January, 1865. March 1st. The Distribution of Sedimentary Rocks in Europe, by H. Habenicht. River Navigation in Southern New Guinea. Views from the High North, by Karl Weyprecht. The Mongols and the Land of the Tanguts. Przewalsky's Journey.

MONTHLY MICROSCOPICAL JOURNAL. — April. On a New Arrangement for Illuminating and Centring with High Powers, by W. H. Dallinger. The Identification of Liquid Carbonic Acid in Mineral Cavities, by W. N. Hartley. On some Structures in Obsidian, Perlite, and Leucite, by F. Rutley. On the Aperture of Object-Glasses, by F. H. Wenham. On Zeiss' $\frac{1}{25}$ Immersion, by W. J. Hickie.

BULLETIN OF THE MUSEUM OF COMPARATIVE ZOÖLOGY. — III., Nos. 11–14. Exploration of Lake Titicaca, by A. Agassiz and S. W. Garman. I. Fishes and Reptiles, by S. W. Garman. Notice of the Palæozoic Fossils, by O. A. Derby, with Notes by A. Agassiz. Recent Corals from Tilibiche, Peru, by A. Agassiz and L. F. Pourtales. The Development of Salpa, by W. K. Brooks.

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[1] The articles enumerated under this head will be for the most part selected.

THE

AMERICAN NATURALIST.

Vol. x. — JULY, 1876. — No. 7.

LAKE WAKATIPU, NEW ZEALAND.

BY I. C. RUSSELL.

LAKE Wakatipu is remarkable not only for the grandeur of its scenery, which some travelers assert is equal to that of witzerland, but also for the many interesting features in its hysical geology.

Lake Wakatipu is situated about a hundred miles from the uthern end of the South Island of New Zealand, among the icturesque mountains of the Southern Alps. Its æsthetic feat- es we will not attempt to describe ; a conception of its varying enes, some of which are as wild and grand as others are soft ld beautiful, can be conveyed only by the brush of the artist ; e endeavor merely to tell the story of their origin.

The lake is of a sigmoidal shape, about seventy miles long, and om one to three broad. Its waters, which are very clear and ld, have been sounded to the extraordinary depth of *fourteen ndred feet.* The surface of the lake being about one thousand et above the sea, its bottom, therefore, is four hundred feet wer than the surface of the ocean. On either side of the lake, d thoughout its whole extent, the mountains rise in a contin- us series of very rugged peaks to a height of from five thou- nd to seven thousand five hundred feet, while Mt. Earnslaw, ich forms the head of the valley, attains an elevation of 9165 t, its top white with perpetual snow, and its sides scored by cending glaciers.

The valley of Lake Wakatipu extends southward beyond the t of the lake for a distance of fifty or sixty miles, and gradu- y spreads out into the low, level country which forms the vince of Southland. As the physical features of the lower tion of the valley are not essentially different from those of immediate shores of the lake, we are forced to consider them

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as having a common origin, and being but portions of the same valley, the upper part of which is filled with fourteen hundred feet of water, and the lower portion by an unknown depth of worn and rounded shingle. The rocks in which the valley is formed are, for the most part, clay slates and gold-bearing mica schists, which are very much curved and twisted, and in many places green with chlorite.

When we look for the causes, the working power that has produced these grand results, the mind becomes awestruck by the magnitude of the forces which have formed not only the grand valley, but the very mountains in which it exists.

What pictures pass before us when we follow in rapid review the great changes that have resulted in the formation of these rugged mountains, gray and scored as they are by time. We see the sediments which for ages have slowly accumulated at the bottom of the sea, and formed the mud and ooze of ancient oceans, by the action of heat and great pressure hardened and crystallized into rock, and then slowly upheaved by the mysterious volcanic forces into lofty mountain chains whose snowy peaks gleam above the clouds, only to be slowly removed, to have great valleys opened in their sides, and their most solid rocks worn away and carried down particle by particle to be spread out once more at the bottom of the sea. If we consider these changes, grand as they are, as but a single circle in the great cycle of geological time, we can appreciate to some extent the wonders of the history that is written on the rocks. It is only to the last chapter in this history — the formation of the valley — that we would ask your attention.

Valleys may be considered as owing their origin, primarily, to one of three causes: (1.) They are formed by a folding of the rocks, thus forming depressions, the sides of which slope inwards towards the axis, hence designated as *synclinal valleys*. Examples of valleys formed in this way are to be met with wherever stratified rocks have been upheaved, as in the Sierra Nevada, Rocky, and Alleghany Mountains. (2.) Valleys are sometimes formed by the fracturing of the earth's crust by volcanic forces. Valleys of this kind are seldom seen, being confined to regions of great volcanic disturbance. (3.) The kinds of valleys above noticed are usually greatly modified by denudation, which is another great agent in their formation. By denudation we understand the wearing away of rocks not only by wind, frost, and rain, but also by the more powerful action of ice and running water, the operation of which we can see everywhere about us.

As the evidence of a synclinal axis is nowhere apparent in the valley of Lake Wakatipu, we are unable to account for its existence by the upheaval of the mountains on either side of it. We are likewise at a loss to find any indication of the rocks having been rent asunder by volcanic forces. The formation of the valley can be referred only to the third cause, that of denudation, or the slow removal by ice and water of the rock that once filled it to a height greater than that of the mountains which now tower above it.

It may seem strange at first sight that such an immense amount of rock — measured by hundreds of cubic miles in the valley of Lake Wakatipu alone — could have been worn down and transported to distant places by the slow action of ice and water. This difficulty would be removed, could our readers stand with us on one of the many lofty mountains which overlook the ake, and see far up at its head, amid many mountains less grand, he snowy summit of Mt. Earnslaw, on whose sides are blue egions of ice; these are the descending glaciers in which lies the ecret of the valley's formation. In those streams of ice that ow down from the snow-fields of Mt. Earnslaw, vast and irreistible as they are, we see but the puny remains of a mighty iver of ice that once flowed through the whole valley of Lake Vakatipu, the extent of which was limited only by the ocean, hich undermined and floated away its extremity in the form of ebergs, in the same manner that they are formed at the present ay on the coast of Greenland. It takes but a glance to conince us that this great ice-river was the engraving tool that, ded by storm and frost, cut in the living rock the picture of onderful grandeur and beauty that is spread out before us.

The glaciers around Mt. Earnslaw are still at work, as they ve been for ages, in extending the valley. The streams that e formed by the melting of the ice are all the year turbid with t, which is the rock that has been ground fine by the glacier, e flour from the mill, which they deposit in the upper end of e lake. In this manner some six or eight miles of the valley s been filled up to a height of a few feet above the usual level the lake. We have but to extend the forces now in operation Mt. Earnslaw to the whole valley of Lake Wakatipu, to have accurate and satisfactory explanation of its formation.

There is another feature of great interest in the history of this ley, first made known by Captain F. W. Hutton, of Dunedin. the shore of the lake, about twelve miles above Queenstown, is a limited deposit of tertiary limestone, containing as fossils, *Ostrea Wullerstorfii*, *Cucullæa alta*, *C. Worthingtoni*, *Panopæa plicata*, and many others. The junction of the limestone with the crystalline rocks beneath can be seen but a few feet below the surface of the lake. The limestone being at the present level of the water, the valley must have been eroded to that depth before the limestone was formed. As its deposition took place beneath the waters of the ocean, the valley was at one time an arm of the sea, and was afterwards upheaved to its present elevation or higher, and the wearing down of the valley continued. We have, therefore, as the sequence of events that resulted in the formation of Lake Wakatipu, the following: —

(1.) The Southern Alps forming a sloping table-land, the highest remaining point of which is Mt. Cook, 13,200 feet above the sea; on this high table-land were deposited immense amounts of ice and snow, brought by the warm, moist winds from the ocean, which formed the glaciers that flowed off in various directions towards the sea. One of these ancient rivers of ice had its source in the region about Mt. Earnslaw, — which, however, was then greatly different from its present form — and flowed over what is now the valley of Lake Wakatipu. This old-time glacier continued its slow motion towards the sea for unknown ages, until it had ground out the solid rock to a depth of five or six thousand feet in vertical thickness, and for over a hundred miles in length.

(2.) The work of this mighty glacier was finally terminated by a sinking of the land, which caused the valley to become an arm of the sea, similar in every respect to the deep, narrow fiords that form such a characteristic feature of the west coast of New Zealand at the present day. What before was an alpine valley filled with hundreds of feet of ice then became the home of huge oysters, and many other forms of marine life, whose remains we now find in the limestone. We know that the sea filled the valley for a long time, since the compact gray limestone that it left behind it was not formed rapidly, as sandstone and conglomerate may be, but the material was first gathered from the waters to form the shells of mollusks and foraminifera, or the hard parts of corals, crinoids, etc., and then these worn down to a fine detritus by the waves and spread out as a calcareous sediment, before the hardening process of rock-making can commence. Together with the limestone are beds of fine shale and masses of conglomerate, composed of both rounded and angular pebbles and containing fossil shells (*Crassatella ampla*) These deposits speak of other although minor changes during the time that the waters of the ocean occupied the valley.

(3.) In the third stage the land is again upheaved to the dignity of a mountain chain, whose lofty summits become covered with vast fields of snow and ice, which, seeking an equilibrium, again flow as a glacier down the valley of Lake Wakatipu. This second extension of the ice-stream down the old valley resulted in the removal not only of most of the limestone that had been deposited, but also of fourteen hundred feet of the crystal-ine rocks beneath. The limestone on the shore of the lake is thus shown to be an inter-glacial deposit, not by being inter-tratified with beds of till, but by the existence above and be-ow it of distinct glacier-worn valleys.

These great glaciers of New Zealand, together with the occur-ence of erratics and moraines in Natal, South Africa, as de-cribed by G. W. Snow,[1] indicate a time of extreme cold in the outhern hemisphere, corresponding to the glacial epoch that left s records — in the form of striated rocks, bowlders, and moraines – over the northern hemisphere as far south as the fortieth par-llel. The limestone of Lake Wakatipu is similar in position to ie inter-glacial lignite beds of Switzerland, as described by rofessor Heer, and to the inter-glacial forest-beds of Scotland id America. Geologists will notice, however, the greater age the limestone of Lake Wakatipu, which, as indicated by its fos-ls, is Upper Eocene, but whether synchronal with the Eocene of urope has yet to be determined.

The great extension of these ancient glaciers may also be ving, in part at least, to a greater elevation of the land.

Either condition returning to those rich and promising islands, ey would again become wrapped in ice and snow, which would ell the ice-streams from Mt. Earnslaw to their ancient dimen-ns and re-create those giant glaciers.

The second glacier, like the first, had its period of great ex-nsion and then slowly passed away. As its terminus retreated the valley it left behind it the material it had gathered from overhanging cliffs along its course, or had torn from the sides the valley, together with the finer products ground by the tom of the glacier from the rocks over which it passed. This terial now forms the filling of the valley below the lake, and been worked over, perhaps many times, by streams of water that have left it in many regular lines of terraces along the sides of the valley, which form a striking contrast with the angular crags and rocks that tower above them.

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[1] Quarterly Journal of the Geological Society, xxvii. 540.

At Kingston, which is situated at the southern extremity of the lake, a huge terminal moraine, composed of cyclopean masses of angular rock, has been thrown by the glacier directly across the valley, and now forms the shore of the lake. In this confused mass of rocks we have indisputable evidence that here for a long time stood the terminal face of the glacier, which ended abruptly, as is common with glaciers at the present day, and formed a wall of ice from cliff to cliff. The reason why glaciers end so suddenly, and are thus enabled to form terminal moraines, lies in the fact that they are flowing from higher to lower and consequently warmer regions, and must eventually reach a point where the warmth is sufficient to melt the ice of which they are composed, although in many instances this limit is not attained until the glacier enters the sea. The rocks which form the terminal moraine at Kingston were once the lateral moraines on the surface of the glacier, which, as the stream moved on and was melted away, were carried over its terminal face — just as trees and blocks of ice are carried over Niagara — and were left in the confused mass that we find them.

Some idea of the time required for this truly herculean task of valley-making may be gathered from the fact that the average motion of the Swiss glaciers can be taken at about twelve inches a day, or one mile in fourteen and one half years. At this rate a block of stone falling upon the surface of the glacier of Lake Wakatipu near its source at Mt. Earnslaw, would require more than a thousand years to reach its final resting-place in the terminal moraine at Kingston, which is only midway down the valley. This mighty mill, therefore, were it now in existence, could have made but a single turn since Christ was born at Bethlehem.

As the warmth increased, the glaciers retreated to their present position around the summit of Mt. Earnslaw, leaving the valley dammed up by the moraine at Kingston, and filled by the water formed by the melting of the ice. On the sides of the valley, in many places, huge blocks of stone were scattered, similar to those in the moraine at Kingston. They also conferred the rounded form of *roches moutonnées* on the low hills and knolls along the shores of the lake.

We have, therefore, in the valley of Lake Wakatipu a striking example of the manner in which glaciers are enabled to form lake basins, not only by the blocking up of narrow valleys by the masses of dirt and stones carried down on the surface of the ice, but also through the wearing down of the rocks throughout the upper and middle course of the glacier at the same time that they are protected from waste at the lower end by the formation of a terminal moraine. Such we conceive to be the simplest, although imperfect reading, of the grand history of Lake Wakatipu. Other great changes probably took place, however, the records of which have been erased.

Nearly the same words may be written of many other lakes which fill rock-basins, or are confined by ancient moraines, like many of the "lochs" of Scotland, and the long, beautiful sheets of water in the State of New York, of which Lakes Otsego and Seneca are examples. The glaciers to which these lakes owe their origin belonged to the glacial epoch of geologists, and were far mightier than the one whose footsteps we have traced. The excavation of the great lake basins between the United States and Canada has been traced back to the same great ice age.

Not only are we allowed to read the past history of this intersting lake, but we may also look beyond the veil that obscures ts future. As the combined action of ice and water have been he instruments for its formation, so are they also working its detruction. After the formation of the moraine at Kingston the waters sought a new outlet from the valley over the falls of the Kawarau, which are constantly being worn away by the action f the water, thus tending to drain the lake to a lower level, as we see by the terraces along its shores that it has been already owered. While the outlet is every moment becoming deeper, he streams that flow from the foot of the glaciers, together with very little rill and rivulet that is born among the mountains, is ontinually bringing down its burden of sediment, however small, hich is deposited in the lake, and does its share towards filling he valley. If this process seems very slow, or inadequate to ccomplish so great a work, we must remember that the operaons of nature, unlike those of man, are not crowded into a brief fe-time, but continue on through ages. The very glacier that t this magnificent valley to the depth of a mile and a half in he solid rock, was formed of the little vesicles of mist that were afted by the wind against the cold mountain-tops, which caused hem to crystallize and accumulate on the summits as snow and e.

The present conditions continuing, where now the deep sea-blue waters of the lake are flushed with the tints of sunset, a rich valley will one day become the home of industry, and its green fields will be animated with the flocks of the husbandman.

A COSMOPOLITAN BUTTERFLY. I. ITS BIRTHPLACE.

BY SAMUEL H. SCUDDER.

THERE is but one butterfly whose range is so extended as to merit the name of cosmopolitan ; it is the Painted Lady or *Vanessa cardui*. With the exception of the arctic regions and South America, it is distributed over the entire extent of every continent. Australia and New Zealand produce a race peculiar to themselves, while the other large islands south of Asia possess the normal type, which is also found upon small islands lying off the western borders of the Old World, the Azores, Canaries, Madeira, and St. Helena. On the other hand, it has not been discovered upon the small islands off the American coast, such as Guadalupe, the Revillagegidos, and Galapagos on the western side, or the Bahamas and Bermudas on the eastern ; neither does it occur in any of the Antilles, excepting Cuba, and there but rarely.[1] It is reported, however, from islands lying in the middle of the Pacific Ocean, such as the Hawaiian group and Tahiti, but its actual occurrence there is at least doubtful.[2]

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[1] Cramer gives it, but probably by mistake, from Jamaica.

[2] The improbability of the occurrence of this insect upon islands lying in the middle of the Pacific Ocean has led me to look carefully into the origin of this general belief. The sole authority for Tahiti is Boisduval, who remarked forty years ago (Nouv. Ann. Mus. Nat. Hist., ii. 191) that he possessed specimens from Tahiti, Brazil, Cayenne, etc.; but it should be noticed that *V. cardui* is not now recognized from Brazil and Cayenne, and that Dr. Boisduval is not considered too careful in his geographical statements ; moreover, Mr. A. G. Butler does not mention it in his List of the Diurnal Lepidoptera of the South Sea Islands (Proc. Zoöl. Soc. Lond., 1874, 274 seq.), and Dr. C. Pickering, the naturalist of Wilkes' Exploring Expedition, tells me that it was unknown on Tahiti in 1839.

The single citation of the Hawaiian Islands will be found in the first list of the British Museum Butterflies, where (p. 79) Mr. Doubleday credits four specimens to those islands, two brought by Captain Byron and two by Captain Beechey. I am informed by Mr. Butler that there is now only one specimen in the museum from the "Sandwich Islands," and the reference upon the ticket is to the oldest manuscript register, not now to be found. Byron and Beechey were at the islands in 1825–27. Mr. W. T. Brigham informs me that *V. cardui* was not found by Mr. Mann and himself during a twelvemonth's residence at the islands ten years ago, and I can find no authority for its present existence. Dr. Pickering writes that it was unknown when Wilkes's expedition visited the islands in 1840–41. The Vincennes, to which Dr. Pickering was attached, was at the islands from the end of September to the beginning of April. Byron and Beechey's visits were between the latter part of January

On the American continent, its southern boundaries will probably be found in Venezuela, New Grenada, and Ecuador,[1] but it is abundant even as far south as the highlands of Guatemala, and thence stretches northward over the entire breadth of the continent to the arctic regions; on the eastern coast it has been found as far as Labrador, and on the west to the eastern shores of Behring's Straits.[2] In the heart of the continent I have taken it upon the Saskatchewan, and Doubleday reports it from Martin's Falls; but Mr. W. H. Edwards does not recollect seeing it in the few collections he has examined from points farther north.

As we see it flourishing in the colder regions of Europe and North America, so also is it found on all mountain heights; and Mr. H. W. Bates, writing of the whole genus, distinctly says it is "found only in elevated places in the neighborhood of the equator." The stations in Southern Asia from which *V. cardui* has been reported, — Cashmere, Nepaul, Bootan, and Sikkim, — all lie on the flanks of the Himalayas, and the Nilgherry Hills are he highest elevations of the Indian peninsula. In the Alps of Europe this insect flies to the snow level; but in North America, lthough it may be regarded as one of the commonest butterlies in the elevated central district, it is most abundant at a level f seven or eight thousand feet. Lieut. W. L. Carpenter and thers have never found it above the timber line; but Dr. A. . Packard, Jr., has taken it on Arapahoe Peak, between eleven nd twelve thousand feet, and on Pike's Peak from eight thousand eet to within five hundred or a thousand feet from the summit.

We naturally inquire, Where did this cosmopolitan creature riginate? Judging from its present distribution alone, we should robably answer: In the temperate parts of the Old World; ecause in the New World it has penetrated but a short distance nto South America, and has established no colonies upon the eighboring islands, excepting on Cuba; while in the Old World

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d the middle of July. Mr. Butler does not consider the specimen in the British useum, nor the record of Doubleday, sufficient authority to include this insect in list of South Sea butterflies. Upon the whole, we cannot fairly accept the present thority for the presence of this insect in the Pacific Islands.

[1] Wagner took a single specimen near Quito in an eight months' residence there.

[2] This statement is made on the authority of Wagner (Sitzungsb. k. b. Akad. iss., 1870, ii. 170), but at the same time he asserts that this butterfly is found on ll the Aleutian Islands," which is certainly incorrect. Lieut. W. H. Dall, whose tural history explorations in Alaska are well known, writes very positively that re are no macrolepidoptera whatever on any of the islands west of Unalashka; a t he easily explains by the absence of trees or shrubs, the strong winds and the le straits that separate the islands. East of Unalashka he knows of but two butflies, a Pieris and a Polygonia.

it has not only crossed the equator, and colonized many of the islands of the Indian Ocean, but has founded a race beyond in Australia and New Zealand, and has reached many of the small islands lying off the coast of Spain and Africa, not to mention the questionable report of its presence on the Hawaiian islands and Tahiti, the affinities of whose populations are with the Old rather than with the New World. But this reply is not wholly satisfactory, although most writers in discussing its distribution have assumed an Old World origin.

To answer this query fairly, we must examine the distribution of the other species of the genus. At first we seem to gain little aid from this source, for we are perplexed by finding that another species, *V. Atalanta*, is also an inhabitant of two worlds, although confined almost exclusively to the north temperate regions of both, which seems a new complication; and, again, that the other species of the genus share between them nearly the entire globe. Thus in the Old World *V. Indica* is found in the region that bears its name; *V. Dejeanii* in the Malayan Archipelago; *V. Itea* in Australia and New Zealand (into which latter island it has probably spread from the former); *V. Gonerilla* in New Zealand; *V. Tammeamea* in the Hawaiian Islands; *V. Abyssinica* in Northeastern Africa; and *V. Hippomene* in Southeastern Africa and Madagascar. While in the New World, *V. Huntera* is found in North America, east (and to a slight extent west) of the Rocky Mountains; *V. Carye* west of the Cordilleras from California to Chili; *V. Myrinna* in the tropics of South America, east of the great mountain chain; and *V. Terpsichore* at the southern extremity of the continent.

But the species of the genus Vanessa (and all the recognized forms are here enumerated) fall into two natural groups: one of these contains such species as have upon the dark upper surface of the wings a conspicuous, bright-colored bow, crossing the middle of the fore wings and skirting, somewhat narrowly, the border of the hind wings; while the other comprises forms on whose upper surface the bright colors (usually some shades of red) nearly or quite predominate, but are broken by the darker parts into irregular blotches on the fore-wings, and form the ground color of the entire outer half of the hind wings, so that all effect of the somewhat regular bow of the other group is lost. There are further differences between them; the species of the former group have the paronychia distinctly bilaciniate, as pointed out by Doubleday; they have also the upper abdominal appendage bifid at tip, and their caterpillars live in a nest formed by drawing together the edges of a single leaf; while those of the latter have the inner lobe of the paronychia rudimentary, the upper abdominal appendage simple, and their caterpillars live in nests formed of many leaves.

Now *V. Atalanta* falls into the former section, and *V. cardui* into the latter; and if we put out of consideration for the moment the distribution of these two butterflies, since they occur alike in both worlds, we find that all the species of the first group are Old World species (including *V. Kammeamea*), and all the species of the second group are New World species. It is difficult to avoid the conclusion, therefore, that these two insects originated, each where its nearest congeners are exclusively found, namely, *V. Atalanta* in the Old World and *V. cardui* in the New; or, using the facts of distribution still further, *V. Atalanta* in Europe and *V. cardui* in North America.

That *V. cardui* should be found upon many of the outlying islands of the Old World, and upon almost none of those which surround its birthplace, is not a matter of much surprise. The butterfly-fauna of islands which have little or no indigenous population is almost altogether made up of a few species of great endurance and which hibernate as butterflies (that is, are longer ived than others in the imago state), and it seems pretty certain that their presence there at all is an accidental circumstance. Mr. J. M. Jones has recently given[1] a very interesting account of the sudden appearance in Bermuda of large numbers of *Terias Lisa*, a delicate-winged butterfly, common enough in the southern United States, but hitherto unknown to Bermuda, where he has detected only *Anosia Berenice*, *Danaida Archippus*, and *Junonia Cœnia;* and he very reasonably accounts for the sudden appearance of these little butterflies by supposing them to have been caught up by the winds in a period of great atmospheric disturbance, and whirled over the sea to this island. Another writer tells of the visit, during a cyclone, of numerous birds and nsects to a ship six hundred miles from the African coast and wo hundred from the Cape Verde Islands; among these were wo butterflies, *Diadema Bolina* and *Vanessa cardui*, the latter t least not yet recorded from the Cape Verde Islands. Other nstances might be given, but from these alone we may reasonaly suppose that of the myriads of insects which perish from such ccidents, a few now and then reach and people some hospitable hore.

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[1] Psyche for November, 1875.

Considering the wide and even tropical distribution of *V. cardui* in the Old World, its absence from South America seems not a little remarkable. But the species of cosmopolitan genera not very rich in species (like Vanessa) are generally conterraneous, or they occupy adjoining zoölogical provinces as equivalent species, species of replacement, or, as the Germans sometimes call them, vicarious species. But we have already seen that, if we leave out of account our cosmopolitan species, and restrict *V. Atalanta* to the Old World, where it actually belongs, each of the species of Vanessa occupies a separate zoölogical region, one adjoining another, over nearly the entire extent of either world. The cosmopolitan species, similarly restricted to the New World as its proper habitat, occupies nearly the same region as *V. Huntera*, extending no doubt farther north, and becoming less abundant toward the southern extremity of the common limits of the two, phenomena which are repeated in the distribution of our two common and wide-spread eastern species of *Argynnis*, *A. Cybele*, and *A. Aphrodite*. The absence of *Vanessa cardui* from South America is therefore rather an argument in favor of its American origin. The presence of the insect on the shores of Behring's Straits, as testified by Wagner, is an indication of its route from America to Asia; and this passage must have taken place in times so far distant that it has had opportunity to push its way even to Australia and New Zealand, and there to become so modified as to establish a peculiar race, once dignified by a specific name. If its presence in the Hawaiian Islands can be proved, such a fact would be more difficult to understand; but we can hardly doubt that *V. Tammeamea* and the other Old World species of Vanessa sprang from one original stock; and if the progenitors of the Hawaiian Islands species found a track from the Asiatic continent, so, plainly, could *Vanessa cardui.*

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THE LOBSTER; ITS STRUCTURE AND HISTORY.

BY J. S. KINGSLEY.

As the season of summer schools is approaching, it has been thought advisable to give a short account of the anatomy of the lobster. This animal has been chosen not only on account of its size and the ease with which either it or its fresh-water cousin, the crayfish, can be obtained, but also from the intermediate position it occupies in the articulata, forming an important type of this branch of the animal kingdom. A few technical terms have been employed, since there is a lack of common names, to aid in explaining the homologies of the various parts.

At the first glance the lobster is seen to consist of a large anterior portion, bearing the pincers and various other appendages; and a posterior jointed portion, the abdomen. Taking the third segment (*somite*) of the abdomen as a starting-point, it is seen to onsist of an upper (*tergal*) and an under (*sternal*) portion. The portion of the segment between these two is called the *pleurum*. On the under side, inserted between the sternum and pleurum, is een a pair of appendages, the swimmerets (*pleopoda*). Each onsists of a basal portion (*protopodite*) and two oval fringed addles, of which the inner is the *endopodite* and the outer the *xopodite*. This we will consider as our typical segment, that is, ve will try to show that all the other somites are formed on the ame plan, with more or less variation of detail. In the sixth bdominal segment these swimmerets will be seen to be greatly nlarged, and the exopodite has a transverse joint. The seventh r last segment (*telson*) has no appendages. Together with the leopoda of the sixth it forms a paddle by which the animal is nabled to propel itself backward in the manner familiar to all ho have ever observed these animals when alive. The pleopoda f the first abdominal somite are also modified; in the female ey are small, slender, and soft; in the male each consists of a rd protopodite and endopodite, the exopodite being absent. he endopodite of the second segment in the male lobster bears additional joint on the inner side.

We now come to the anterior portion of the body, in which e segments are not so distinctly marked. It is covered with a rge dorsal shield, the *carapace*. In front it is produced, be- een the eyes, into a long spine, the *rostrum*. In the middle a groove which indicates the position of the heart in the in- rior. It certainly does not indicate the line of separation of e head and thorax.

We are enabled to separate the anterior portion into somites m the fact that for every pair of jointed appendages there is corresponding segment. Proceeding forward from the abdo- en with our homologies, we first find the fifth or last thoracic ab, which differs greatly at first sight from the swimmerets. consists of a protopodite and a jointed endopodite; in its rlier stages it had also an exopodite. With the thoracic limbs ew feature appears; to the limb or the sternum at the base the limb are attached one or more conical appendages consisting of little lamellæ fastened together, forming a gill. These gills are packed away under the carapace. There are twenty on each side. The fifth limb bears one. In the fourth we find still another organ, a thin leathery structure with scattered hairs, the *epipodite*, the function of which is to keep the gills apart. This limb bears four gills, as do the third and second. In the second and third limbs the inner distal angle of the next to the last joint is greatly elongated, forming with the last joint a pincer or *chela;* limbs thus formed are said to be *chelate.* The first pair of thoracic limbs are greatly enlarged, and it is the outer instead of the inner angle of the joint next to the last which is elongated to form the pincer. It bears three gills.

We now come to the appendages of the head, and among them we again find the exopodite. The six posterior pairs are commonly called the "mouth parts." We first find, in going forward, three pairs of *maxillipeds*, each composed of a protopodite, exopodite, and endopodite. The outer pair are larger than the others, the basal joints are hard and toothed like a saw; they bear each three gills. The second pair bear one small gill and the third are gilless. In front of the maxillipeds are the two pairs of maxillæ. They are delicate, almost membranous. The epipodite of the posterior one, called *scaphognathite*, is in life in constant motion, baling out water from the gill cavity, thus creating a current over the gills and aiding in respiration. We next come to the mandibles, a pair of hard protopodites with cutting edges, and a delicate three-jointed endopodite termed a *palpus*. Between the mandibles is the mouth. It is bounded behind by a bifurcated process, the *metastoma*, and in front by a simple enlargement, the *labrum*. In front of the mouth the sternal surface bends abruptly upward. Above this flexure we find the larger antennæ, which consist of a protopodite and endopodite, the exopodite being represented by a small spine. Still farther in advance are the smaller antennæ, called the antennulæ. This finishes the number of segments. Reviewing, we see that we have eight cephalic, five thoracic, and seven abdominal. It will be seen that the writer does not recognize any segment corresponding to the eyes, and that he believes the telson to be a somite. The reasons for the former are chiefly embryological; for the latter, the fact that the intestine passes through it, together with certain reasons derived from the development of the young lobster. The mere absence of appendages has no great weight.

The internal anatomy is best studied by removing part of the carapace and tergal portions of the abdominal segments, as shown in the plate, taking care not to injure the underlying organs. Beneath the shell will be found a reddish membrane, which must also be carefully removed. The heart will be seen to be an irregular hexagonal body, lying just behind the suture noticed in speaking of the carapace. It consists of a single ventricle contained in a sac improperly called the *pericardium*. It gives off in front an artery to the eyes and anterior part of the body. Close to this on each side is the hepatic artery. On the under side is the sternal artery, while from the posterior angle arises the artery which supplies the abdomen. The sternal artery connects with one which runs the length of the body on the under side. Respiration is carried on in the gills. The heart forces out through these various arteries the blood, which collects in a *venous sinus*, passes to the gills, and then back to the heart.

In front of and surrounding the heart is a delicate, convoluted mass, the liver, which occupies a large proportion of the thoracic cavity. In it are imbedded two elongated bodies, *ovaries* or *testes*, according to the sex, which pass under the heart. They are connected in front of the heart. Behind this connection are he *oviducts* of the female or *vasa deferentia* of the male.

The mouth, the position of which has been noticed, is connected with the œsophagus, which in turn empties into the stomch. This latter is a large sac in the anterior part of the body, nd consists of anterior and posterior (*cardiac* and *pyloric*) portions. In the cardiac is a complex calcareous organization perated by powerful muscles, the office of which is to finish the mastication of the food. In the pyloric portion is a ciliated strainer. The intestine is a straight tube extending beneath the eart from the pylorus to the anus, which is situated on the uner side of the telson. At the base of each antenna is the "green land," supposed to be a kidney; it communicates with the exterior by an opening in the protopodite.

The "brain" is found at the base of the rostrum, between the yes. It gives off nerves to the eyes, the antennulæ and the antennæ. From the posterior portion are given off two commissures, which pass around on either side of the œsophagus and unite in a ganglion behind. To examine this and the succeeding thoracic ganglia, it will be found necessary to carefully break down part of the sternum. From each of the œsophageal commissures arises a nerve, the two uniting in front of the stomach and giving rise to the sympathetic nerve. From the infra-œsophageal ganglion arise the nerves which go to the mouth parts. The thoracic ganglia are connected by two commissures, the abdominal by a single cord. The sternal artery passes between the commissures, uniting the third and fourth thoracic ganglia. There is no ganglion for the telson.

The only senses which are localized in the lobster are sight and hearing. The position of the eyes has been noticed; the ear is found as a small sac in the base of the antennulæ.

Space will allow but a slight account of the development; for details the reader is referred to the papers of Mr. S. I. Smith, in Verrill and Smith's Report on the Invertebrata of Vineyard Sound, and in the Transactions of the Connecticut Academy of Science. (See also the NATURALIST, July, 1874.) The eggs are of a dark green color, and are found from April to November on the coast of New England. The embryo in the egg has its eyes sessile, its antennæ are simple sacs, and its abdominal feet are wanting. In the first stage after leaving the egg the thoracic feet are furnished with an endopodite fringed with hairs. The animals then swim on the surface. In the second stage some of the abdominal appendages appear. In the third it loses its exopodites, and begins to resemble the adult. Specimens three inches long have been found with nearly all the characters of the adult. During the first year the molts are quite frequent, but afterwards they are believed to occur but once a year. The carapace splits down the back, and through the opening the animal withdraws itself, leaving its œsophagus and stomach within the cast-off skin, and in a few days the new skin becomes hardened.

EXPLANATION OF PLATES V. AND VI.

Plate V. Fig. 1, carapace; 2–8, abdominal segments; 2′, side view of the first abdominal somite of male; 9, antennulæ; 10, antennæ; 11, mandibles; 12, 13, maxillæ; 14–16, maxillipeds; 17, big pincer; 18–21, remaining thoracic feet; 22, front view of third abdominal segment; 23, transverse section through the carapace.

Plate VI. Fig. 1, dorsal view, part of the carapace removed, giving a schematic view of the internal anatomy, a portion only of each organ being represented; 2, nervous system; 3, diagramatic figure of the circulation (from Gegenbauer); 4, embryo in the egg (from Smith); 5, first stage of young (from Smith).

E, eye; ex, exopodite; en, endopodite; ep, epipodite; f, flexor muscles; g, gill; h, heart; h. a, hepatic artery; i, intestine; l, liver; m. a, anterior median artery; n, nerve; p, protopodite; p. a, posterior artery; p. c, pericardium; r, rostrum; s, stomach; t, ovary or testes; v. a, ventral artery; s. a, sternal artery: v. s, venous sinus; x, extensor muscles.

PLATE.

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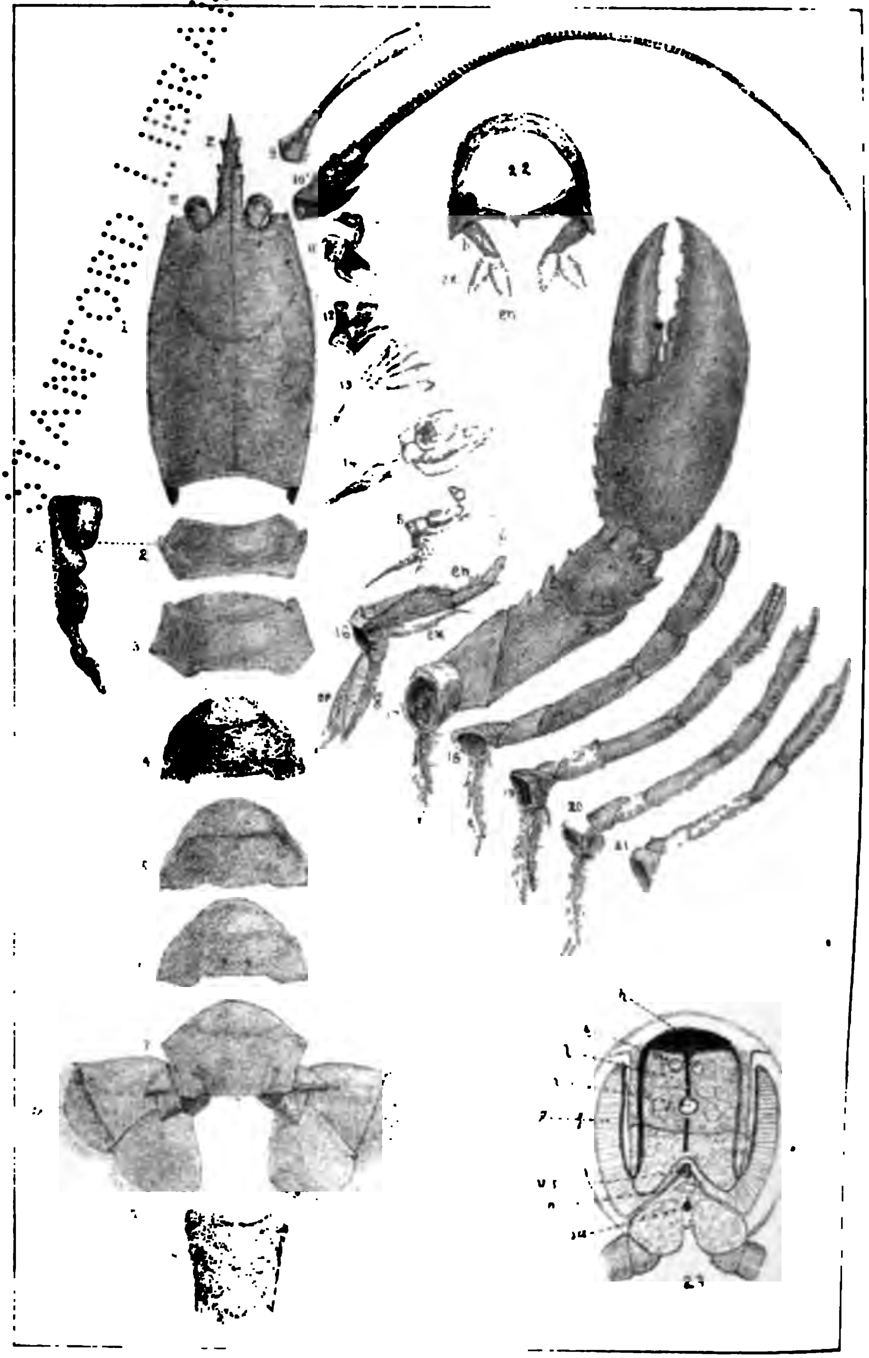

Anatomy of the Lobster

PLATE VI

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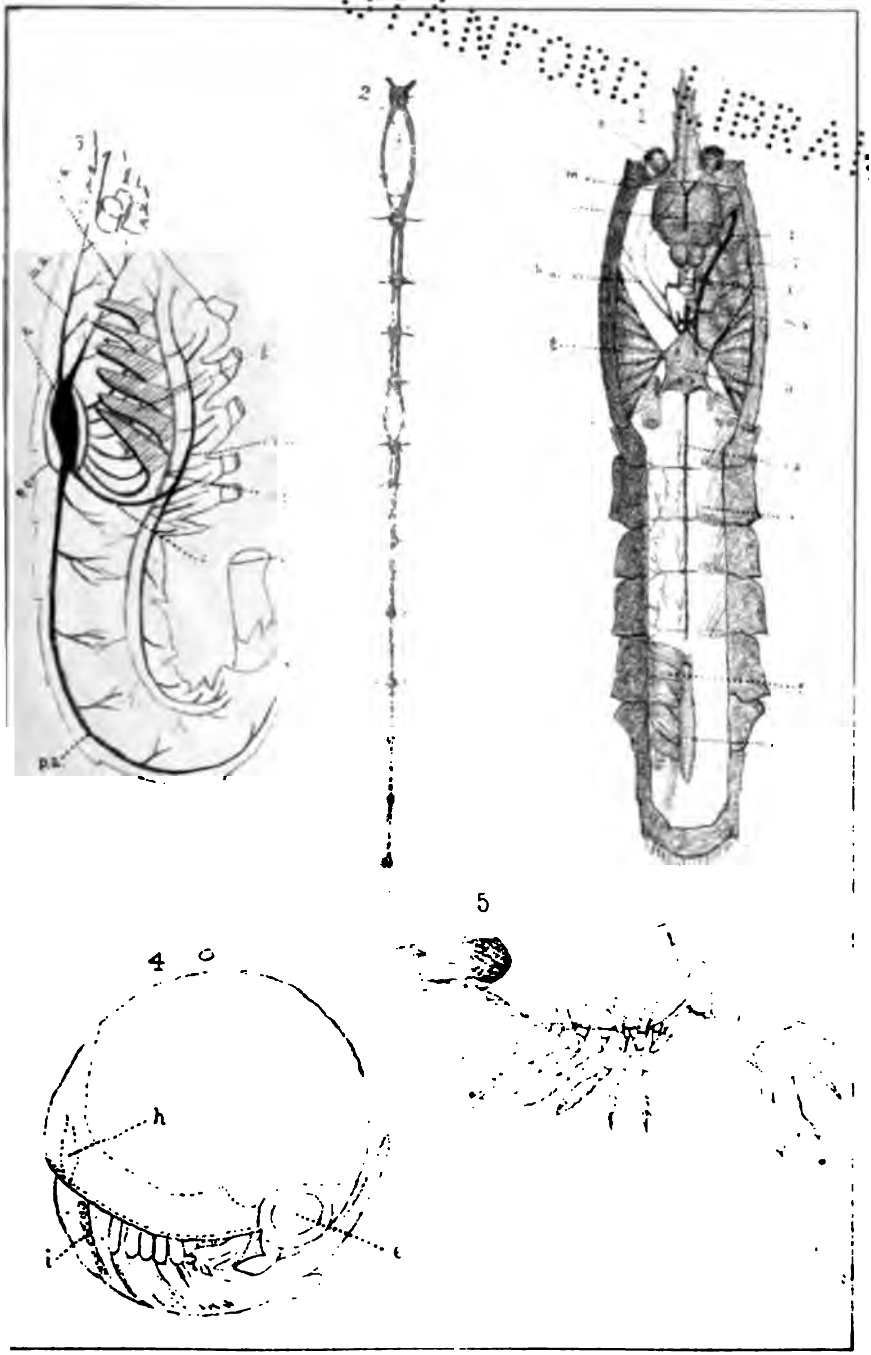

Anatomy and Development of the Lobster.

THE PROBABLE DANGER FROM WHITE ANTS.

BY DR. H. A. HAGEN.

I INVITE the reader to imagine himself in a forest in the interior of Brazil. There is a clearing in the forest. A small valley covered with underbrush, and containing a fresh water pool, opens before our eyes. Here and there are scattered little hills several feet high, more or less covered with grass. Thick clouds rise slowly and make the close air still more oppressive; the rainy season, the disagreeable summer of the tropics, is approaching. All seems quiet, but suddenly one's attention is attracted by a strange activity beginning in one of the little hills.

As if by witchcraft, a cleft opens in the middle of the hill. A little brown insect comes out with folded wings, followed by two, three, four, and more, in one row, as many as the quickly widen-ing cleft will allow to pass at once. Like a silver ribbon the train winds down the hill, for the membrane of the wings glimmers like nother-of-pearl. These insects take a course just opposite to the wind, as this is the only way in which their delicate wings can esist the pressure of the air. More and more, without interrup-ion, appear hastily, as if driven out of the hill. Other similar lefts have been opened, from which similar trains throng out. The little hill seems to discharge its living lava like a volcano. But the most curious spectacle is seen near the cleft. There ppear little wingless creatures with enormous heads and hooked aws, which they move threateningly, to defend the entrance to heir subterranean chambers, and to accelerate the march of their rethren who have been turned out. At last the rows grow maller and thinner and the clefts begin to close as if walled up by visible hands. In the mean time the swarm has tried its wings, nd rises steadily into the air, keeping close together near the ops of the trees and then gradually falling to the earth. Pretty on the number of the falling insects increases, and we notice hat they are always in couples, male and female, running quickly bout and trying to get rid of their loosely attached wings.

Continuing to observe the strange kind of emigration of these sects, commonly called white ants, we find that only a few of hese myriads live till the next morning. All those that have ot been eaten by the large numbers of mammals, birds, and ptiles eager to swallow them have been caught by the busy workers of the white ants, and elected as heads of a future family. A clay cell, shaped like a watch-glass, serves for the royal pair, first as a dwelling and later as their grave. They are never allowed to leave it. The entrance is carefully walled up, and at first only one small hole is left for the workers to go in and out. Food is brought in and consumed. The queen grows visibly, and begins soon to lay the eggs of the coming brood. The number of eggs is immense ; the statements vary between eighty in every minute and eighty thousand in twenty-four hours. As the same queen continues to lay eggs for two years, at least in some species, some forty millions of eggs will have been laid during this time. This large number is not exaggerated ; indeed, the fecundity of some common insects goes much beyond this. The common blue-bottle fly has in one summer five hundred millions of descendants, and the plant-louse has in one year, in the fifth generation, six thousand millions, and still continues to lay eggs when the ninth generation is already fit for propagation. Among the vertebrates some fishes have a comparatively numerous progeny.

The growth of the queen increases in proportion to the number of eggs forming in her body. When full-grown she is several thousand times as large as before ; that is, her abdomen only has grown from one half an inch to six and even eight inches in length. The whole body resembles a thick worm, covered at regular distances with brown spots, the former segments of the abdomen. The delicate feet are completely unable to move the body, out of which the eggs are forced by an incessant peristaltic motion.

Meanwhile the cell of the so-called queen has been widened according to necessity. A gang of workers, forming a chain, moves about the floor and carries the eggs into the nurseries near by. To shorten the way they make little holes in the walls of the cell at regular distances. Soon we find a motley crowd crawling about in the nest ; very young larvæ, workers and soldiers, two aborted forms of both sexes, nymphæ, and later, mingled with them, the full-grown winged imago.

But the nest has become too small, and we now see similar hills rising near by ; then the partition walls are broken to connect the new dwellings with the old ones ; and additions to the family force the brood to repeat the operation. Larger species in the tropics raise hills to twelve feet and more in height, strong enough to resist the influence of the tropical rains, and to render difficult their destruction by men or animals.

The whole is built up by the blind workers in the dark, for it is a peculiarity of the white ants that they shun the daylight. No matter how far they intend to go, they build *a pipe of clay* of about a quill's diameter, forming a viaduct, the inside of which is quite smooth, whilst the outside is more or less rough. It is wonderful how quickly the work progresses. In a file each worker carries to the right place a small particle of loam, mixed with its saliva. Without interruption the little troop is busily engaged, and such pipes have been observed to progress two inches in a single hour, and six feet during one night.

When the work is damaged, the workers retire, frightened, and in the breach appear the thick-headed soldiers; first one, then more, in such a hurry that often the foremost are thrown down by the eagerly pressing crowds. Opening their jaws wide, they move their heads threateningly to reach the enemy, and at the same time make a peculiar hissing sound. Furiously they beat at everything in their way, and not infrequently put to flight barefooted intruders. The soldiers do not help at the work; protection is their only duty. They are blind, like the workers.

There are some very curious facts observed concerning the instinct of these little animals. As the whole nest would die with the premature death of the queen, sometimes two equally well-developed queens are found in the same cell, but the rather impolite workers have built between them a partition, beginning at the ceiling but not quite reaching the floor. Therefore only conversation is possible; perhaps they think that two queens would not live peaceably so near together. Every society provides carefully for a substitute in case of the queen's death, and in a small cell, shaped like that of the queen, two or three individuals are found, prepared, if wanted, to take her place.

All the species of the white ants which build hills belong to the tropics. But besides these, there exist numerous species which build curious nests in the tops of trees, or beneath the surface of the earth, or which live in decayed trees and in every kind of decayed wood. Two of the latter kind, very similar to each other, live in Europe and North America; and about these in particular, and their dangerous habits, I propose to make some observations.

The European species (*Termes lucifugus*) has been observed by naturalists for nearly a century. The little dark-brown insect, living under stones or in old decayed trees, had until recently never been injurious. Even its appearance in myriads after the falling of an old uninhabited house in Rochefort, in France, did not draw the attention of the people to the danger. Some time afterwards more accidents happened. In a boarding-house a whole dinner party fell suddenly from the third story down into the cellar, and some other buildings threatened similar mishaps. The danger was increased, as each owner carefully denied having these fearful guests, for fear of depreciating the value of his house. The anvil of an industrious blacksmith yielded under his hammer, and the block supporting it broke to pieces, entirely destroyed by white ants. The attention of the government was drawn finally to the danger by the destruction of the costly timber stored in the navy yard for the building of men-of-war, and the destruction of the naval archives. Several times scientific commissions were sent to investigate the new pest and to propose remedies; and scientific societies in vain offered prizes for the fortunate destroyer of these animals. Nevertheless every remedy proved useless, as refuse and manure spread the obnoxious insects further. Constant attention and the destruction of the pipes, and use principally of only metal and stone for the construction of new buildings, were considered the only remedies against the white ants. Some years later they did less damage, and disappeared, as insect pests commonly do, without any known reason. For the last twenty years they have existed everywhere in the formerly infected departments, but without being obnoxious.

The North American species (*Termes flavipes*) in form and color is very much like the European, but differs in the more yellowish legs. The species has been known to science since the end of the last century. Their obnoxious power was first shown in Europe, in the beautiful hot-houses at Schoenbrunn, belonging to the Emperor of Austria. The insect was believed, probably by mistake, to have been imported with plants from South America, for till now this species has not been observed south of the North American continent. It was not possible to get rid of them in Schoenbrunn, in spite of great expense and careful labor. One of the largest hot-houses was so nearly destroyed by them that it had to be torn down to prevent its falling to ruin. Besides the beams, they had destroyed the tubs in which the plants were set. The new hot-houses were built of iron, but the white ants are still living in them.

The whole region of the United States east of the Rocky Mountains possesses only one species, the above-mentioned *T.*

flavipes, spreading from the Gulf to the Lakes, and from the Atlantic to the westward beyond the Mississippi. This white ant seems to be common everywhere; it is very abundant in New England, and from my personal observation is to be found everywhere around Boston, in its suburbs and in the surrounding country, within a radius of ten miles. It lives in old stumps, in dead trees, and in fences, logs, and every kind of rotten wood. So far as is known, living trees are not attacked.

The full-grown insect swarms in June more or less numerously, and nearly every year local newspapers give some account of an irruption. Curiously enough, and although many observers were eager to follow the insects to their nest, till recently none had been discovered. Only a few months ago, in the southern part of Florida one was found by chance in an old rotten log, nd the queen sent to the Cambridge Museum. I have tried to iscover the nest here since I was invited to come to Cambridge y the late Professor Agassiz, and I have repeatedly given serious ttention to this subject. But I never succeeded. I beg to nention only one of my experiments. A board which lay about wenty steps from the corner of the museum when I arrived, ight years ago, was left in the same spot five years for the purose of covering wet places in the spring and in the fall. Sudenly in June, 1872, it proved to be infested and covered with housands of white ants. Of course they must have come through e ground, and I tried carefully to discover the passages and oles, in order to find a clew to the nest. The whole ground beeath the board and its neighborhood was examined, and the loam refully displaced. But no trace was found. I have no doubt at some old stumps in the surrounding estates will be the ght place, but they are too numerous to enable us to find the ght one. The only scientific conclusion to be made is that the hite ants spread commonly very far around their nest underath the ground, and appear above as far as possible from the st. It is very obvious that by this habit the danger is aggrated, and the remedy, that is, the destruction of the nest, fficult to apply.

My inquiries as to whether there had been observed any misief done by white ants here were always answered in the negae. Only one fact was known. About ten years ago, in a hotuse at Salem, the grape-vine was destroyed by them, and riously enough in the same way as in Europe, and I am inmed that the sills of houses and decaying trees in that city are tenanted by them. Two years later I was presented by the late B. Walsh, in Rock Island, with a copy of the state papers of Illinois, which were destroyed by white ants. All the spare copies were stored in a closed room, and not looked after for some time; when the room was opened all were found in the same condition. I can never look upon the volume without being puzzled by the remarkable fact that the queer little rogues failed to attack the name of Vandalia on the top of the pages. Several years later a Boston lady, a teacher in one of the freedmen's schools in South Carolina, who had gone away for a vacation of six weeks, found, on returning, the whole library destroyed, Bibles and prayer-books. The copies kindly forwarded to me were less damaged, and therefore retained.

Here, around Boston, old fences are the favorite dwelling of the white ants. The old fence around the Observatory in Cambridge was the easiest place to collect them. The fence was replaced last fall by a new one. In the report the expense was marked down as a large one. If we consider the danger to the library and the records of the Observatory, which, once destroyed, never could be replaced, we shall agree that the expense is a real benefit. In the Botanical Garden, white ants are equally numerous. A few years ago I had the opportunity of seeing white ants swarm in clouds in the Botanical Garden. A whole army ascended the steps to the herbarium. I was frightened by the possible danger to this treasure. But the answer that all the plants in the herbarium were poisoned turned directly my compassion to the side of the little strolling wanderers. Nevertheless, the costly library of the Botanical Garden is certainly not poisoned, and doubtless somewhat in danger. I tried to find the centre for the large distribution of white ants around the Observatory and the Botanical Garden, and I believe I am right in regarding it as existing in a very old estate just opposite to the Botanical Garden. Near Spy Pond I had for several years a good collecting place for white ants in a venerable giant of pine, dead perhaps for many years, but removed the last winter; in the many old stumps around it, however, the nest was not discovered.

Near Winchester, on Mystic Pond, the fish commission has built a remarkable fishway for alewives, near a sluice. Two years ago I examined the posts and stumps around it, and found them infested with white ants. Till now they have done no damage. I have no positive information that mill-dams are damaged by white ants, but I cannot help believing that at least in some cases of ruptures of dams, so frequent of late years, white ants may have had some part at least in helping the destruction. The same remark applies to wooden bridges. I can only give one fact which I believe belongs here. Near Porter's Station, in Cambridge, was a wooden bridge for cattle driving, which gave way, as it was stated, by a large number of cattle running across it. Trains stop forty times or more daily at Porter's Station, and the bridge was so situated just above the engine that it was moistened by the hot steam, the best accommodation which white ants would choose. I am told that the broken wood had been sound, but I can state that white ants swarmed last year on both ends of the broken bridge. Even now the outside of the old bridge remains near the newly-built one, and the wood is thoroughly rotten and eaten by insects. I have always wondered that houses were never attacked. Now it is done. Some years ago, Mr. Alvan Clark, the world-wide known maker of astronomical instruments, visited the Museum of Comparative Zoölogy. When I showed him the biological collection of white ants, he told me that he knew them very well, because they swarmed every year in January in his workshop. Afterwards, while I was on a visit there, he showed me that the timber around the furnace in his shop was entirely infested by them. This year, suddenly the ceiling above the furnace, where the wood is constantly moistened by hot steam, gave way for about an inch, and he was obliged to support the whole by posts and jack-screws. A gentleman from Roxbury, when I showed him wood damaged by white ants, told me that an old shanty on his estate came down, and the wood looked just like the piece I showed him. From some lumbermen I heard that such wood was known by the name of powder-dust, and I found beautiful pieces of it among large piles of lumber near Lake Winnipiseogee. I am happy to state that I know of no other damage done here by white ants. But their habit of working without injuring the outer surface of the eaten wood, and the immense damage done by a nearly-related species, makes it a duty, I believe, for everybody to be on his guard. White ants are every year swarming around the Museum of Comparative Zoölogy, the Botanical Garden, and the Observatory. Collections and large libraries are in the neighborhood, and it should not be forgotten that A. von Humboldt stated half a century ago that the rarity of old books in New Spain was the consequence of the depredations of white ants. I have no proof that white ants are living in the city of

Boston itself, but there can be no doubt of it. Old posts, plankways, fences, stumps, are everywhere their favorite dwelling, and there is no lack of this sort of rubbish in many places. In East Boston their appearance was recorded several years ago by newspapers.

The question, What can be done to prevent as much as possible the danger? is a natural one. I have thought much about what should be recommended, and I will try to give some hints which may perhaps be accepted. The remedies (the large number of which shows their insufficiency) recommended for the destruction of white ants in the tropics fill a whole literature. I will not forget to mention that as every calamity is used by rogues to cover their bad doings; even the destruction by white ants was used in such a way. When a very large property, stored by the government in Isle de France, was reported as destroyed by white ants, the ministers sent to the officers a box containing files, with the strict order to file off the teeth of each ant or to resign the place. Since then the white ants have been harmless, at least comparatively so.

The substance of the propositions recommended by me would be as follows: —

(1.) We must know that we live surrounded by such enemies, and that great destruction can be done. If we look straight in the face of an enemy and know the power he can develop, the battle is half won. Nothing is more dangerous than underrating or overlooking the power of even the feeblest enemy.

(2.) We must not try to find a remedy to exterminate them entirely and at once. Such exertions are fruitless. We must try to diminish the danger to the smallest possible degree. The life of man is a continuous struggle with a host of enemies which he cannot exterminate. They must be avoided or conquered.

(3.) The remedy must be a reasonable one. For instance, it would be absurd to recommend not to build houses of wood in a country where certainly wooden buildings are the most healthy, considering the great changes of temperature, the great humidity of the air, and above all the convenience of such houses.

The diminishing of the progeny of animals is done in the simplest way by depriving them of food. Now the food of white ants is principally old rotten wood, and I think the first step should be to take away all that is possible of such stuff. Old stumps are the principal dwellings for white ants, preserving them through the winter. Therefore every old stump should be removed, at least near cities and towns. For old fences, I believe this will be more difficult, but I see no other help, at least near cities and towns. It should not be overlooked that a sudden removal of a large quantity of such infested wood might bring about a sudden calamity by a larger spreading of the disturbed and starved animals. But it should also be considered that in leferring this necessary remedy the evil would be greater, and nly postponed; the ants would spread more and more, and a ater generation would deplore the lack of attention given by heir forefathers. I think if the removal was effected in winter ime, when the ants are weaker, and a large part would die in the old weather by exposure, or by simple chemicals put in the hole, he danger would not be so great that it could not be overcome.)f course I would condemn also all useless pieces of wood lying round, also old forgotten shanties and similar structures.

A very important point would be not to have well-manured ower-beds just around and near to the wall of wooden dwelling-ouses. The soil in such beds is always less compact and warmer, nd I have observed in such beds in the early spring swarming hite ants. I think it would be best to have around the houses r a certain distance clay or gravel, as the white ants do not em to like them.

It should be remembered that in railway depots and stations e engines should not stop daily on a spot where bridges or nilar wooden structures are moistened by the steam. Of course e same precaution would be commendable in manufactories.

These seemingly not very significant measures, if followed rictly, would, I think, prevent the greatest part of the danger. ntinued attention would be the principal, and this would be sy, as the swarming of the white ants in the summer indicates every one their presence.

I should be sorry if the lugubrious picture of the possible amity, which may seriously endanger a flourishing country, uld be thought too darkly shaded or perhaps sensational. is has of course not been my intention. I have only tried to w attention to an enemy with which we have lived until w peaceably, without knowing its dangerous power, a power ich can be developed at any time, if precautions are not taken destroy it.

White ants are only the police of nature. If mankind takes police in his hands, nature steps behind. White ants retreat p by step before the advancing culture. In Africa and India, where a century ago immense ant-hills were to be found near the shore, now some days' journeys inland have to be made to find them. We are justified in hoping for this retreat of white ants here, in front of a rapidly advancing culture.

EXPLORATION OF A MOUND IN UTAH.

INFORMATION having been received that a mound existed on Santa Clara River, a few miles from the village of St. George, in Southern Utah, which from its position promised to yield interesting results, it was deemed of sufficient importance to have it explored. Dr. E. Palmer, being in that neighborhood last fall, was requested to direct the operations in the interest of the National Museum. The report which he submitted gives interesting details of what he observed during the progress of the work, and his impressions explanatory of the same.

With the necessary workmen and tools he proceeded to the mound in question, on the east side of the Santa Clara River, about three miles from St. George, Utah, and camped at its base. A general view of the situation showed an isolated elevation which had originally covered about half an acre of ground with a varying height of ten or twelve feet, which had been cut away nearly one half on the side of the river by the action of its waters during a freshet in 1861 or 1862. The outline it presented on the ground was quite irregular. The rise in the river had changed the position of the channel, and deepened it and also made it wider. At this time, however, the stream is reduced to a very small width, say from twelve to fifteen feet. What remained of the mound was quite a conspicuous object in the landscape, about forty feet from the river-bed, with a vertical escarpment on that side, but evidently it had been a circular work before its partial demolition by the river. The lines of stratification seen on the river front were conclusive as to its having been piled up by human agency, showing various horizons from the base up, on which dwellings had been erected and occupied by the residents of the spot until some member of the household, probably the head, should die, when it was burned down with all its appurtenances, the dead body included; leaving a deposit of ashes with incombustible stone implements to designate the location.

The construction of the dwellings was studied out on the spot and was found to be for the most part of upright sticks or staves probably wattled, supporting a roof made of slender poles, which sustained a grass thatch covered with mud for the outer layer. Others had a stone wall or foundation, laid up with clay mortar. The included space was square, shown by a well-defined line of ashes where the walls had been burned down, with bits of charcoal scattered over the surface which were derived from the poles of the roof, while over all was an almost continuous layer of clay, burned to the hardness of soft brick, which had covered the roof. These brick-like masses still preserved the impress of the wood upon which the clay had been plastered. The amount of ashes in each little inclosure differed somewhat, in proportion to the thickness of the roof, and the quantity of household implements or provisions which it may have contained at the time of the conflagration. The location of the domestic hearth seemed to be distinctly shown by the accumulation of a mass of ashes, semicircular in form, and ten or twelve inches deep. In several instances large flat stones were found neatly arranged around these fire-places, as if to retain the fire in its proper limits. Other inclosures or pens of slabs of rock were noticed, and were interpreted to be storing places for provisions. All the rock material used in and about the buildings was brought from a distance, probably by water-carriage on the river, there being no stone quarry near the place. There could not be discovered any regular disposition of the buildings in rows, circles, or around a square, but their location seemed to have been determined by some such event as the burning down of one dwelling, and the necessity of erecting another in some quarter at a distance, for the occupancy of the survivors.

Some portion of the skeleton of the cremated Indian was always found within the inclosure marked out by the lines of ashes. The effect of the fire had been to destroy the body, and what remained of the bones crumbled on exposure to the air; a portion of one or two crania being all that could be brought away. Many other objects were also found, such for instance as stone mortars, metates, pestles, grinding-stones, flint arrow and spear heads, earthenware jars, and such other Indian implements or property as could not be destroyed by the fire.

Adjacent to the skeletons was found what was judged to be an intended provision of water and food, arranged in appropriate vessels; those for water being generally of the same globular shape. The vessels were of hard-burnt earthenware, for the most part of a grayish color and ornamented inside with parallel black lines, with occasional triangular or quadrangular black spots.

These pots or jars or bowls, to the number of three, five, seven, and ten respectively, were discovered in connection with remains of the dead, as the several house floors were dug up and cleared away. In a few instances no earthenware was discovered; small deposits, however, of substances which were charred or otherwise decomposed pointed out where provisions had been left for the sustenance of the departed spirits. Throughout the whole mound refuse bones from food-animals of many species were discovered, and all exhibited signs of being split for marrow, or otherwise worked or handled.

Before any of the tribe to which the deceased belonged could be induced to erect another dwelling on the old site, much time, probably a generation or two, would have to elapse. In obedience to a powerful superstition and fear of the dead no one would be likely to reoccupy the ground until the name and character of the former occupant had been forgotten. In the mean time the old foundation would have to be filled up to the general level, and for this purpose earth would have to be brought from another quarter. That the descendants should cling to the old mound of their forefathers is in accordance with all aboriginal tradition, and a home on such a mound, surrounded by neighbors, might well be regarded as a place of security and defense from attack. This latter idea probably determined all such cases of the selection of mounds for permanent residence in those times. The people of this particular locality were of the usual stature, and from all their properties and surroundings are judged to most resemble the Moquis and Pimos; certainly they must be classed with Pueblo tribes, and the quality of the pottery and its ornamentation point directly to the Indians just named as their descendants. Thus, with the unchanging pertinacity of the race, the same place if not the same spot was built upon, destroyed by fire, and rebuilt upon, the same mode of life, customs, manufactures, being continued for ages, until the want of food or water, some overwhelming epidemic or murderous raid of enemies, brought extinction to the little colony.

The posture observed in placing the deceased before burning the dwelling and contents is that noticed all along the western coast of North and South America: the knees were drawn up and the chin rested upon them; and no rule seems to have been observed in facing the individual, no one of the cardinal points being regarded more than another. Some of the specimens of food discovered near the skeletons are charred or decomposed, but still bear distinctive marks by which they can be certainly determined, such as corn and pine nuts: and the traces of slowly evaporating water clearly indicate its former presence in the appropriate vessels, which were generally globular in shape with a narrow neck or contracted orifice. Household utensils for grinding corn or seeds, stone knives and implements for skinning and dressing animals for food and for use in converting the skin into leather, stone tips for arrows and heads for spears, stone awls or drills for making perforations, stone hammers, celts, axes, grooved stones for smoothing arrow shafts, stone disks, probably for gambling purposes, several flat stones such as are now used by kindred tribes for baking, a stone pipe for smoking tobacco or its substitute, and a very large number of sharp-pointed bone awls were obtained, uch as are now in use by many tribes for puncturing holes in uckskin for sewing. They are remarkably well preserved and lid not crumble on exposure; a result due probably to the previous limination from the bone, by cooking, of all animal matter which night promote decomposition. No ornament or other object was ound which could be referred to a European or other foreign rigin. Some rough beads made of shell or bone were all, except hat in one place a few small flat stone pendants of a greenish-blue olor, perforated for stringing and made of the celebrated and are turquoise or chalchiuitl, were found in connection with a keleton probably of a chief, judging from the more than usual gns of opulence which surrounded him. These trinkets are obinable only, so far as is now known, in one locality, namely, the erillos Mountains in New Mexico. Connected with these were endants made of the iridescent pearly shell Haliotis, the nearest lace for obtaining which is the shore of the Pacific Ocean.

In one stratum of ashes there were discovered some fragments of arred textile fabric, very coarse, but unmistakably twisted and aited; hence we may infer that some other clothing was in use sides the buckskin garment. The fibres of which these are ade could easily be obtained from an agave or a yucca, fibrearing plants, which abound in Utah and Arizona.

The series of objects obtained which forces itself most upon the ention was the collection of earthenware vessels, nearly fifty in mber. The choicest lot was of seven pieces in connection with e skeleton, associated with some very neatly made arrowheads, flat stone with serrated edge, the turquoise pendants above med, bone ornaments, stone drills, bone awls, red paint (for the e), and an exceedingly sharp knife of obsidian. Some of the better forms and finer kinds of pottery were near children's skeletons. The form, color, and ornamentation of the ware is very various, and the latter is often elaborate. Some pieces were glazed, that is, if we are to understand by this term that the vessel has been coated over, after it is shaped in ordinary clay, with a finer earthy mixture, which fuses into a kind of glass, making a smooth reflecting surface. The addition of an outer coating of finer material upon which to impress some kind of ornament can be shown also in other instances from Utah and Arizona to be very ancient.

The pottery vessels when extricated from near the interior of the dwelling were entire and undefaced, but where they had been exposed near the edge or margin to moisture or influence of saline efflorescence they were cracked and the glazing had scaled off.

The quantity of broken pottery strewn around the environs is only a repetition of what may be found in wonderful profusion all over the adjoining Territories of Arizona and New Mexico. The quality of the ware, the shape, and the uniformly characteristic ornamentation declare unmistakably that the tribes which manufactured the articles are now represented by their descendants the Moquis, Pimos, and Maricopas living north of the Gila River and forming the tribes of Pueblos or settled Indians of that country. The immense quantity of this pottery may be well accounted for by remembering that in such an arid country the most urgent and never-ceasing demand was for water to allay thirst. To provide for this it was customary to arrange rows of ollas or water jars of large capacity, sinking them up to their necks in the sandy soil so as to check evaporation from the surface, and, when opportunity served, to fill them and thus keep a store of the precious fluid at hand. Something analogous is seen in the rows of capacious jars of similar ware which have been found embedded in the soil near the ruins of Nineveh, in the Isle of Cyprus, and on the site of ancient Troy. Oil or wine or water, all or either of them, may have been contained in the latter, but the fragments of pottery on these sites are also very numerous and similarly accounted for.

PROFESSOR TYNDALL'S EXPERIMENTS ON SPONTANEOUS GENERATION, AND DR. BASTIAN'S POSITION.[1]

BY REV. W. H. DALLINGER.

THE largest difficulty surrounding the question of the mode of origin of septic organisms is that of discovering their life-cycle. By dealing with them in aggregations we run told and untold risks. The conflict of results by this means, in the most accomplished hands, employing the most refined methods during the past eighteen years, is a sufficient witness. Repetitions of experiments, and conflicting results, and explanations of the reason why, and so the cycle rolls. Of course important lessons in biology are learned, but not *the* lesson. And yet by the eachings of this complex and doubtful method *alone* Dr. Bastian s content to accept "abiogenesis" as a great fact in nature.

To those who are best acquainted with the experimental his-ory of the subject for the last twenty — but certainly for the ix — years this is the more remarkable. For the weight of vidence is certainly not only *not* in favor of "abiogenesis," but s in the strongest sense adverse to it. The most refined, deli-ate, and continuous researches all point to the existence of what re at present ultra-microscopic germs. This, indeed, is directly ffirmed by the authors. A single and recent instance will suf-ice. After a remarkable series of experiments detailed before he Royal Society, Dr. W. Roberts says: "The issue of the oregoing inquiry has been to confirm in the fullest manner the ain propositions of the panspermic theory, and to establish the onclusion that *bacteria* and *torulæ*, when they do not proceed om visible parents like themselves, originate from invisible erms floating in the surrounding aërial and aqueous media."

But further, this has been remarkably sustained by analogical idence. There are putrefactive organisms that closely approx-nate to the bacteria in form, structure, and size. These are e "*monads*," or, as Professor Huxley doubtless more fitly ames them, the *Heteromita*. They live side by side with the cteria in the same putrescent mass, and certainly in the later ages of the disintegration of dead organic matter are the most tive and powerful agents. From their greater size they present more promising field for microscopical research than the bac-ria themselves; and the life-history of some of these could be lly mastered. I long since felt that valuable aid might thus be rendered to the discovery of the nature of the bacteria. Armed with the best and most powerful appliances which the modern optician could supply, Dr. J. Drysdale and myself ventured on the work. The results are fully detailed elsewhere. It need only be remarked here that the only hope of success was in *continuous* observation of the same form, in the same drop of fluid under the highest powers. The secret, therefore, was to find a means of keeping the same drop under examination without evaporation. This we did. The result was that patient work enabled us to completely unravel the life-history of six of these organisms. These life-cycles cannot be here recounted. Suffice it now to say that each of them multiplied enormously by self-division (fission), but that the life-cycle in *each case* began and ended in *a distinct genetic product* — call them what we choose, spores, germs, or ova.

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[1] Extracts from an article in Popular Science Review, London, April, 1876.

We have here, then, important indications of fact concerning the nearest allies of the bacteria: they develop from germs.

We have, besides, the weight of the best experimental evidence pointing clearly to the existence of germs in the bacteria themselves. But the microscope has failed to *demonstrate* the latter. Its finest powers and finest methods failed to reach them.

Happily at this juncture Professor Tyndall has stepped in, and with his accustomed brilliance and precision has opened up the path we need. *He has presented us with a physical demonstration of the existence of immeasurably minute molecules of matter — utterly beyond the reach of the most powerful combination of lenses yet constructed — which are the indispensable precursors of bacteria in sterilized infusions.*[1] In short, he has opened up a new and exact method, which must lead to a scientific determination of the existence and nature of the bacteria-germs. His beautiful experiments on the decomposition of vapors, and the formation of actinic clouds by light, led him to experiment on the floating matter of the air, and with what results is widely known. Confined and undisturbed air, however heavily charged with motes, becomes at length, by their deposition, absolutely clear, so that the path of the electric beam is invisible across it. From this, and associated indications, he acutely inferred "that the power of developing life by the air, and its power of scattering light would be found to go hand in hand;" so that a beam of light sent across the air into which infusions might be placed and examined by the eye, rendered sensitive by darkness, might be utilized with the best results in determining the existence of bacteria-germs. To bring the idea to a practical result a number of chambers were constructed with glass fronts. At two opposite sides facing each other a couple of panes of glass were placed to serve as windows, through which the electric beam might pass. A small door was placed behind, and an ingenious device was arranged to enable a germ-tight pipette to have free lateral, as well as vertical, motion. Connection with the outer air was preserved by means of two narrow tubes inserted air-tight into the top of the chamber. The tubes were bent several times up and down, " so as to intercept and retain the particles arried by such feeble currents as changes of temperature might ause to set in between the outer and the inner air."

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[1] Nature, January 27, 1876, page 252, and February 3, page 268.

Into the bottom of the boxes were fitted air-tight large test-ubes, intended to contain the liquid to be exposed to the action f the moteless air.

" On September 10th the first case of this kind was closed. he passage of a concentrated beam across it showed the air ithin it to be laden with floating matter. On the 13th it was gain examined. Before the beam entered, and after it quitted e case, its track was vivid in the air, but within the case it anished. Three days quite sufficed to cause all the floating atter to be deposited on the sides and bottom, where it was tained by a coating of glycerine, with which the interior surce of the case had been purposely varnished. The test-tubes ere then filled through the pipette, boiled for five minutes in bath of brine or oil, and abandoned to the action of the motes air."

In this way the air in its normal condition was freely supplied the infusions, but of mechanically suspended matter it could demonstrated that there was none. And it was proved, with clearness that admits of no quibble, that infusions of every d, animal or vegetable, were absolutely free from putrefactive anisms. " In no single instance . . . . did the air which had n proved moteless by the searching beam show itself to pos-s the least power of producing bacterial life or the associated nomena of putrefaction." But portions of the same infusions osed to the common air of the Royal Institution Laboratory continuous temperature of from 60° to 70° Fahr. fell invaly into putrefaction; and when the tubes containing them unted to 600 in number not one of them escaped infection — y were all "infallibly smitten." Here is irresistible evidence that there is a direct relation between a mote-laden atmosphere and bacterial development. The whole series of Dr. Tyndall's exquisite experiments is simply an irrefragable affirmation of this truth. The presence of the physically demonstrated motes is as essential to the production, in a sterilized infusion of septic organisms, as light is to actinic action. They cannot be made to appear without the precursive motes; they cannot be prevented from appearing if the motes be there. That these are the germs of bacteria by themselves, or associated with minute specks of matter, approximates to certainty in the proportion of hundreds of millions to one.

A beautiful illustration of the minuteness and multitude of the particles is given. Let clean gum mastic be dissolved in alcohol, and drop it into water; the mastic is precipitated and milkiness is produced. Gradually dilute the alcoholic solution, and a point is reached where the milkiness disappears, and by reflected light the liquid is of a bright cerulean hue. "It is in point of fact the color of the sky, and is due to a similar cause — namely, the scattering of light by particles small in comparison to the size of the waves of light."

Examine this liquid with the highest microscopical power, and it appears as optically clear as distilled water. The mastic particles are almost infinite in number, and must crowd the entire field of the microscope; but they are as absolutely ultra-microscopic as though they had no existence. I have tested this with an exquisite $\frac{1}{50}$ of Powell and Lealand's, employed with a new and delicate mode of illumination for high powers,[1] and worked up to 15,000 diameters; but not the ghostliest semblance of such particles was seen. But at right angles to a luminous beam passing among these particles in the fluid "they discharge perfectly polarized light." "The optical deportment of the floating matter of the air proves it to be composed, in part, of particles of this excessively minute character," and it is among the finest of these ultra-microscopical particles that Professor Tyndall finds the sources of bacterial life. It is almost impossible to conceive a nearer approach to certainty concerning the nature of these minute particles than this. Their minuteness, their capability of being physically demonstrated, the absolute necessity of their presence to the origination of bacteria in sterilized infusions of any and every kind, taken in connection with what we *know* concerning the germs of the *Heteromita* whose life-histories have been studied, render it simply inevitable that we have at length reached, what we are justified in believing to be, a genetic product of the bacteria through which their continuation as organisms is preserved. When first I saw the simplicity and beauty of this method, it struck me that its applicability as a test in reference to germs — *known to be such* — would have considerable collateral weight; and a method of employing it was suggested by a fact in past experience.[1] I had in my possession a maceration of cod's head, which I had kept in use for eleven months. It had become a pulpy mass, and in the middle of January last it was comparatively free from bacteria, but swarmed with two monads — the fourth and sixth of the series described by my colleague and myself. To ascertain their exact condition, I watched them on the "continuous stage" for three consecutive days, and found that both forms were to be seen plentifully emitting spore. The maceration had become very short of moisture, which served my purpose. I subjected it to a dryer air with a higher temperature, and it was not very long in becoming a moist pulpy mass, with sufficient cohesiveness to be removed from the vessel; and in this condition it was placed in a heating hamber, which was slowly raised to a temperature of 150° Fahr., nd kept at this for an hour. This was 10° Fahr. higher than Dr. Drysdale and myself had proved necessary to destroy absoutely every adult form. The baked mass now appeared cracked, orous, and flaky. In parts it was extremely friable, and with ittle pressure crumbled into almost impalpable powder; while y friction a very large proportion was reduced to the finest dust. To avoid all possibility of error this powder was again exposed n the heating chamber, spread over a plate of glass, to a temperture of 140° Fahr. for ten minutes — thus rendering the plea of ere desiccation impossible.

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[1] Monthly Microscopical Journal, April, 1876.

A chamber or box was now prepared precisely like Professor yndall's, except that there were no tubes to communicate with e outer air.

In the Researches on the Life-History of Monads we had proved at they could live, thrive, and multiply almost as well in ohn's "nutritive fluid" as in the normal animal infusion. his fluid is composed of phosphate of potash, sulphate of magsia, triple basic phosphate of lime, tartrate of ammonia, and stilled water. If these ingredients are all mingled the fluid comes speedily charged with bacteria, unless hermetically sealed, and sometimes even then. We therefore keep the ammonia in a separate solution, mixing them when required.

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[1] Monthly Microscopical Journal, xii. 262, 263.

A portion of the fine dust of the maceration was now taken and thoroughly scattered through the air of the prepared chamber. The condensed beam from an oxyhydrogen lime-light[1] was then sent through it. Its line of passage was far more brilliantly marked inside the chamber than in the outer air. It was deemed inexpedient to insert the fluids while such brilliant points were visible in the air, and four hours were suffered to elapse. The lime-light beam was still visible with perfect distinctness, but its path within the chamber was much less brilliant and more homogeneous than it was without. The fluids were then carefully mixed, and five small glass basins of the mixture were inserted. The whole was undisturbed for five days. At the expiration of that time the beam of the lime-light sent through the chamber was absolutely invisible, although perfectly clear in the open air on both sides of it.

The fluids were now withdrawn. Ten "dips" were taken out of each basin for microscopical examination. *In every "dip"* — that is, fifty in all — *one or other of the monads appeared, and were in a state of active fission;* and in twenty-seven of the "dips" both monads were found. Bacteria swarmed the field, which of course I fully expected.

I now took five *other* glass vessels, and inserted them with great care into the now moteless air of the chamber, and poured in, as before, fresh Cohn's fluid. They were exposed for another five days. On careful microscopical examination of seventy-five "dips" *not a single monad of either form appeared;* bacteria were feebly present, but of course no steps were taken to guard against these, and, as before, they were anticipated.

The air of the chamber was again impregnated with dust, as before, suffered for a time to settle, and *these same vessels of fluid*, which had yielded negative results, were again placed in the chamber. At the expiration of five days they were again examined, *and one or other of the monads was found in every successive "dip."*

Now let it be observed that there can be no possible error as to the forms. They were the identical species of the maceration, with which I am as familiar as with a barn-door fowl. What, then, is the logic of these facts? Dr. Tyndall proves that bacteria only develop in sterilized infusions when the air around them is laden with motes of incalculable multitude and exquisite minuteness. Given the presence of these, and the development of bacteria is inevitable. The inference is that the motes are *germs.* The above experiments show, that in closely allied septic organisms, the germs of which have been demonstrated and their developments watched, if the dry *débris* of a maceration in which these forms are found be scattered in the air around a prepared fluid, and demonstrated by similar optical means, that the said organisms develop; but if the minute dust from the *débris* be optically proved to be *absent*, none of the monad forms appear. Here we do not hypothecate a germ, but we *know* that it exists; and its deportment in similar conditions is identical with that of the assumed bacterial germ. Do we need more irresistible evidence that the bacteria develop, not *de novo*, but from genetic products?

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[1] This was of course very much less capable of "searching" than the electric beam; but it served for the rougher end I had in view.

Now, until Dr. Bastian's promised "new results"[1] have appeared, I believe I am justified in affirming that the strongest cases on which even he relies for "spontaneous generation" are recorded on pages 175, 180, of his Evolution and the Origin of Life. They are thus introduced: "After this I may, perhaps, be deemed fully justified in quoting two *very typical* experiments for the further consideration of those who stave off the belief in spontaneous generation — either by relying on the insufficient reasons for doubting the influence of boiling water, or because of their following Pasteur, Cohn, and others in supposing that certain peculiar bacteria germs are not killed except by a brief exposure to a heat of 227° or 230° F. For even if we could grant them these limits, of what avail would the concession be . . . in the face of the following experiments?" The details of the experiments follow. They are alike in method, and we will concern ourselves only with the second. A strong infusion of common cress, with a few of the leaves and stalks of the plants, were inclosed in a flask, which was hermetically sealed while the fluid within was boiling. It was then introduced into digester and gradually heated, and afterwards kept at a temerature of 270–275° F. for twenty minutes, and was retained t a temperature, if the time of heating and cooling be considred, over 230° F. for one hour. This flask was opened after ine weeks. The reaction was acid; the odor was not striking. On microscopical examination with a $\frac{1}{12}$ inch objective "*there ppeared more than a dozen very active monads.*"

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[1] Times, January 29, 1876.

Now, fortunately, Dr. Bastian has not only carefully measured and described these organisms, but he has drawn them, and they are reproduced on the frontispiece of the book. He describes them as the $\frac{1}{4000}$ of an inch in diameter; they were provided with a long, rapidly moving lash (flagellum), by which granules were freely moved about. But, besides this, "*there were many smaller, motionless, tailless spherules, of different sizes, whose body-substances presented a similar appearance to that of the monads*, and of which they were in all probability earlier developmental forms."[1]

Now, by careful comparison, I find that this monad is no other than the "uniflagellate monad," which is the fourth in the series whose life-histories were studied by Dr. Drysdale and myself.[2]

(1.) Dr. Tyndall has proved, in connection with a host of others, but in a more definite and precise manner, that in *filtered infusions* five minutes' boiling does kill every form of bacteria.

(2.) He has further shown that they are propagated by demonstrable germs *only*, in such infusions; and

(3.) This fact removes the probability of their spontaneous generation to an almost infinite distance.

As to the development of bacteria in infusions charged with solid matter, precise experiment of a sufficiently comprehensive character has yet to be made on them, in relation to the demonstrated germs. Meantime, shall we accept "spontaneous generation" on such ground as its strongest advocate has now to offer, and ignore the vast chain of facts copiously attested and controlled, which are in perfect harmony with the known laws of the entire organic world? This, and nothing less than this, is what Dr. Bastian inculcates and demands.

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RECENT LITERATURE.

PICKERING'S ELEMENTS OF PHYSICAL MANIPULATION.[3] — The first volume of this useful manual we noticed at the time it was published; the second, now before us, is more extended in its range than originally intended by the author, and will be still more valuable for students. This volume treats of electricity, heat, mechanical engineering, meteorology, practical astronomy, and lantern projections. The author suggests that the laboratory method may be used to teach astronomy as successfully as chemistry or physics; and accordingly considerable space is given to this subject, sufficient instructions being given to enable the civil engineer or explorer to be able to determine his latitude, longitude, and time, by the sextant or transit. The chapter on lantern projections will be found useful to lecturers on scientific topics, who need the lantern as a means of illustration, and to know how to produce the best results by simple and inexpensive means.

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[1] Evolution, page 178.

[2] Monthly Microscopical Journal, xi. 69, *et seq.*

[3] *Elements of Physical Manipulation.* By PROF. E. C. PICKERING. Part II. New York: Hurd and Houghton; Boston: H. O. Houghton & Co. 1876. 8vo, pp. 316. $4.00.

HAYDEN'S REPORT ON THE GEOLOGY OF COLORADO.[1] — This report is almost entirely devoted to geology, comprising the observations made by Professor Hayden and his assistants in 1874. The volume is mainly filled with the reports of Professor Hayden, Dr. A. C. Peale, and Mr. F. M. Endlich. Dr. Samuel Aughey contributes a valuable chapter on the surface geology of Nebraska, and Mr. L. Lesquereux a report on the Tertiary flora of the North American Lignitic, considered as evidence of the age of the formation, with a review of the cretaceous flora of North America; an extended and very fully illustrated report on the ancient ruins in Southwestern Colorado, by Mr. W. H. Jackson, is followed by an interesting essay on the molluscs of the Rocky Mountains, by Mr. Ernest Ingersoll, illustrated by some anatomical drawings. Under the head of Topography and Geography, are reports by Messrs. Henry Gannett, S. B. Ladd, A. D. Wilson, and Franklin Rhoda. The volume is certainly in interest and practical value not behind its predecessors.

BAIRD'S ANNUAL RECORD OF SCIENCE FOR 1875.[2] — This volume will be found indispensable to the general public, and of value to the special student who may want a popular summary of discoveries in all departments of science. We think that the present Record is more valuable than its predecessors, from the greater space (272 pages) devoted to the General Summary of Progress. Appended is a list of some of the more prominent scientific publications published during 1875. The full index gives evidence of careful editing. The present volume is a still more useful register of progress than the others of the series, and giving as it does a fair proportion of space to American discoveries, deserves the widest circulation.

RECENT MEMOIRS ON NORTH AMERICAN MAMMALS. — Dr. Gill's Synopsis of Insectivorous Mammals[3] is not by any means limited to the

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[1] *Annual Report of the United States Geological and Geographical Survey of the Territories, embracing Colorado, and parts of Adjacent Territories; being a Report of Progress of the Exploration for the Year* 1874. By F. V. HAYDEN. Washington. 1876. 8vo, pp. 515. With numerous illustrations.

[2] *Annual Record of Science and Industry for* 1875. Edited by S. F. BAIRD, with the assistance of eminent men of science. New York: Harper and Brothers. 1876. 12mo, pp. 656.

[3] *Synopsis of Insectivorous Mammals.* By THEODORE GILL. Bulletin of the United States Geological and Geographical Survey of the Territories. No. 2 (pp. 92–124). Second Series. Washington: Government Printing Office. May 14, 1875.

Insectivora of North America, as it was undertaken partly in continuation of his Arrangement of the Families of Mammals and "partly for a general work on the mammals of North America," and hence discusses the characters and mutual affinities of the insectivorous mammals of the whole world. To those who are already familiar with Dr. Gill's former excellent work in this line, it will be sufficient to say that it is a work of the same thorough character as his former essay on the *Educabilia*, published in 1872.[1] He gives first a general history of the subject, which includes a critical notice of the views of the different systematic writers who have given these animals special attention, beginning with Cuvier, who in 1816 first combined them into a single distinctive group, down to the recent mature classification of Professor St. George Mivart, first published in 1867 and revised in 1872. The schemes of classification of the leading authorities are quoted *in extenso*, and the gradual progress noted from Gray's crude and fanciful combinations (1823–1843), and the later more natural ones of Gervais (1854) and Wagner (1855), to the more highly improved schemes of Peters (1864), Mivart, and Gill (1872); while the retrograde system proposed by Fitzinger (1867–1869) receives the unfavorable criticism it so well deserves. Gill, in 1872 and in the present memoir, agrees essentially with Mivart in respect to the number and constitution of the families, but differs from him somewhat in respect to their order of sequence and combinations.

Wagner, in 1855, first referred the peculiar genus *Galeopithecus* to the Insectivora, which genus had previously been associated with the lemurs by some writers, with the bats by others, and by others regarded as an isolated type. This recognition of its affinities was subsequently adopted by Peters, and later met with the approval of Mivart and our present author.

The *Insectivora* constitute the sixth order of mammals in Dr. Gill's scheme of classification, which order he subdivides into two suborders, the *Dermoptera*, consisting of the *Galeopithecidæ*, or so-called "flying lemurs," and the *Insectivora vera*, including all the other families. These are the *Talpidæ* and *Soricidæ* (combined into a "superfamily *Soricoidea*); the *Erinaceidæ* (= superfamily *Erinaceoidea*; the *Centetidæ* and *Potamogalidæ* (= superfamily *Centetoidea*); the *Chrysochloridæ* (= superfamily *Chrysochloroidea*); the *Macrocelididæ* and *Tupayidæ*; (= superfamily *Macrocelidoidea*). An extinct family *Leptictidea* (American), is also recognized. The order, suborders, families, and subfamilies, are each elaborately diagnosed. A list of the genera with their synonymy is also appended as well as a list of the monographic essays treating of the different groups, with also some remarks on "Range of Variation," with a "genealogical tree," and remarks on the "Geographical Relations of the American species." Finally is added an "Appendix" respecting the American species, in which is given a table of the contrasted characters of the *Soricidæ* and *Talpidæ* — the only American families — with a synoptical list of the general works and special papers that relate to them.

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[1] *Arrangement of the Families of Mammals. With Analytical Tables, prepared for the Smithsonian Institution.* By THEODORE GILL, M. D., Ph. D. Washington: Published by the Smithsonian Institution, November, 1872. 8vo, pp. vi. 98. (Smithsonian Miscellaneous Collections, 230.)

The foregoing imperfect synopsis of Dr. Gill's excellent memoir is sufficient to show that it is a paper of very great importance to students of American mammalogy.

QUARTERLY BULLETIN OF THE NUTTALL ORNITHOLOGICAL CLUB.[1] The first number of this new ornithological journal appears with an excellent steel engraving of a new species of *Helminthophaga*, from a drawing made by Mr. Robert Ridgway. The nine articles are by Messrs. W. Brewster, C. J. Maynard, J. Warren, W. Van Fleet, C. M. Jones, H. W. Henshaw, and R. Deane. The number is well printed and is creditable to the club.

RECENT BOOKS AND PAMPHLETS. — Elements of Physical Manipulation. By Edward C. Pickering. Part II. New York: Hurd and Houghton; Boston: H. O. Houghton & Co. 1876. 8vo, pp. 316. $4.00.

Eighth Annual Report on the Noxious, Beneficial, and other Insects of the State of Missouri. Jefferson City. 1876. 8vo, pp. 185.

Life of Israel Putnam. By Increase N. Tarbox. With maps and illustrations. Boston: Lockwood, Brooks, & Co. 1876. 8vo, pp. 389. $2.50.

Working People and their Employers. By Washington Gladden. Boston: Lockwood, Brooks, & Co. 1876. 12mo, pp. 241. $1.75.

Words; their Use and Abuse. By William Mathews, LL. D. Chicago: S. C. Griggs & Co. 1876. 12mo, pp. 384. $2.00. For sale by Lee and Shepard, Boston.

Report upon the Invertebrate Fossils Collected in Portions of Nevada, Utah, Colrado, New Mexico, and Arizona, by parties of the Expeditions of 1871, 1872, 1873, nd 1874. By Charles A. White, M. D. From vol. iv. Palæontology of Report of Wheeler's Survey United States Engineer Department. Washington. 1875. 4to, p. 219. 21 plates.

Manual of the Apiary. By A. J. Cook. Lansing, Mich. 1876. 8vo, pp. 59.

Injurious Insects of Michigan. By A. J. Cook. (From Report of State Board of griculture for 1874.) Lansing, Mich. 8vo, pp. 48.

List of the Zoölogical Works and Memoirs of P. L. Sclater, 1850–75. (Printed r Private Distribution.) London. 1876. 8vo, pp. 32.

A Catalogue of the Published Works of Isaac Lea, LL. D. From 1817–76. Phildelphia. 1876. 8vo, pp. 22.

Further Notes on "Inclusions" in Gems. By Isaac Lea. Philadelphia. 1876. vo, pp. 11.

On Viviparous Echini from the Kerguelen Islands. By Alexander Agassiz. (From e Proceedings of the American Academy of Arts and Sciences.) 1876. 8vo, pp. 5.

Notes on the North American Ganoids, Amia, Lepidosteus, Acipenser, and Polyon. By B. G. Wilder. (From the Proceedings of the American Association r the Advancement of Science.) Salem, Mass. 1876. 8vo, pp. 43.

Is Nature Inconsistent? By B. G. Wilder. (From the Galaxy.) New York 76. 8vo, pp. 10.

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[1] Published by the Club, at $1.00 a year; single numbers, 30 cents. Address H. Bailey, 13 Exchange Place, Boston, Mass. 8vo, pp. 28.

The Mollusks of the Rocky Mountains. By E. Ingersoll. (From Popular Science Monthly, May, 1876.) 8vo, pp. 7.

Handbook for Young Sportsmen ; a Treatise for the Amateur Devotees of Field Sports and Angling. By Will Wildwood. Milwaukee. 1876. 16mo, pp. 94, 25 cents postpaid. For sale by D. H. Eaton, Peotone, Ill.

Concerning the Fishes of the Ichthyologia Ohiensis. By D. S. Jordan. (Bulletin Buffalo Society of Sciences.) 1876. 8vo, pp. 6.

Quarterly Bulletin of the Nuttall Ornithological Club, Cambridge, Mass. Vol. i. No. 1. April, 1876. Published by the Club. 8vo, pp. 28. $1.00 a year; single numbers, 30 cents. Address H. B. Bailey, 13 Exchange Place, Boston, Mass.

Contributions to the Natural History of Kerguelen Island, made in connection with the United States Transit of Venus Expedition, 1874–75. By J. H. Kidder, M. D. Vol. 2. Washington, D. C. 1876. 8vo, pp. 122.

Catalogue of the Fishes of the Bermudas. By G. Brown Goode. Bulletin 5 of the United States National Museum. Washington, D. C. 1876. 8vo, pp. 82.

Bulletin of the United States Geological and Geographical Survey of the Territories. Vol. ii. No. 3. Washington, D. C. June 5, 1876. 8vo, pp. 197–277.

Ninth Annual Report of the Trustees of the Peabody Museum of American Archæology and Ethnology. Cambridge. 1876. 8vo, pp. 56.

Bulletin d'Insectologie Agricole, Journal Mensuel de la Société Centrale d'Agriculture et d' Insectologie, Entomologie appliquée. 1re année. Nos. 1–5. Paris, 1875–76. 8vo.

On the Occurrence of Eozoön Canadense at Côte St. Pierre. (From the Quarterly Journal of the Geological Society for February, 1876.) London. 8vo, pp. 10, with a plate.

GENERAL NOTES.

BOTANY.[1]

SCHŒNOLIRION *Torr.* — This is the name given by Dr. Torrey to an Asphodelineous, Liliaceous genus, founded on *Phalangium croceum* of Michaux, a native of Georgia. Elliott, having what he supposed to be Michaux's plant, transferred it to *Ornithogalum*, and described the petals as white, with a mark of doubt. Later, Scheele, in *Linnæa*, xxiii. 146, published an *Ornithogalum Texanum* with white flowers, from Lindheimer's Texan collection. In the Botany of the Mexican Boundary Survey, issued in 1859, Dr. Torrey characterized the present genus and a species, *S. Michauxii*, referring to it Michaux's original plant "floribus croceis," the plant which Elliott had taken for it, and which was now known, from Florida specimens collected by Mr. Buckley and Dr. Chapman, to be white-flowered, and likewise the Texan plant which was equally white-flowered. The blossoms of these sometimes turning yellowish in drying, Dr. Torrey too hastily concluded that Richard, the editor of Michaux's Flora, had mistaken such originally white flowers for saffron-colored, and so changed the specific name in order to correct an error while he honored the discoverer. Dr. Chapman, in his Southern Flora, adopted Dr. Torrey's view, he knowing of a white-flowered species of his district; but he long ago expressed to us the opinion that this could hardly be Michaux's original species. Dr. Wm. T. Feay, of Savannah, several years ago had the good fortune to meet with the original yellow-flowered species, and the acuteness to mark the distinctions. But only this spring was he able to procure fresh specimens, and to place them in my hands for confirmation. My attention being thus called to this genus, it was not difficult to ascertain that my lamented associate had brought together, under his name of *S. Michauxii*, three nearly related but distinct species. This does not include still another plant, of which a flowering raceme only, collected by Mr. Pratten in California, had been submitted to him by Mr. Durand, and which, at his suggestion, was published in Durand's *Plantæ Pratteniana* under the name of *Schœnolirion album*. I know nothing of this Californian species, and it certainly needs confirmation. I can, however, perfectly identify the original species. When examining the Michauxian herbarium at the Jardin des Plantes, in 1839, I could find no specimen of this rare "*Phalangium croceum.*" I sought and found it, however, in the herbarium of L. C. Richard, the editor of Michaux; and the possessor, Achille Richard, kindly permitted me to take a capsule and a couple of flowers, which, with my notes, are still preserved. Now that we know there is a yellow-flowered species, I cannot doubt that this is Michaux's plant, and it inhabits a district which he repeatedly traversed. Moreover it is also well described by Nuttall (Gen. Pl. i. 220), who distinctly states that the flower is "saffron-yellow," a statement which Dr. Torrey must have overlooked. The species may be distinguished by the following brief diagnosis: —

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[1] Conducted by PROF. G. L. GOODALE.

(1.) S. CROCEUM. Flowers saffron-yellow; divisions of the perianth oblong, 3-nerved; filaments nearly filiform; leaves (arid, gramineous, *Nutt.*) narrow and tougher than in the following, *Phalangium croceum*, Michx. Fl. i. 196; Nutt. Gen. i. 220. Southwestern part of Georgia, Michaux, Feay, etc.

(2.) S. ELLIOTTII *Feay.* Flowers white; divisions of the perianth oval, mostly 5-nerved; filaments subulate. *Ornithogalum croceum*, Ell. Sk. i. 397, excl. syn. *Schœnolirion croceum*, Torr. quoad syn. Ell.; Chapm. Fl. 483. S. Georgia and Florida.

(3.) S. TEXANUM. Flowers white; divisions of the perianth oblong, 3-nerved; filaments subulate. *Ornithogalum Texanum*, Scheele in *Linnæa*, xxiii. 146. *Schœnolirion Michauxii*, Torr. Bot. Mex. Bound. 220, xcl. syn. Michx. and Ell. E. Texas, and adjacent borders of Louisiana.

S. ALBUM. Durand, Pl. Pratt in Jour. Acad. Philad. n. ser. iii. 103, f California, needs confirmation. — ASA GRAY.

ANTHERS IN TRILLIUM. — These are described, and on the whole cor-ectly, as introrse in *Trillium*, while they are extrorse in *Paris*, and in he Himalayan *Trillidium*, which is between the two. The species ary some, such as *T. cernuum*, having an almost marginal dehiscence.

And Mr. M. W. Vansdenberg, of Fort Edward Academy, New York, an acute correspondent, has pointed out a marked exception in the case of *Trillium erythrocarpum.* This has the most slender filaments of all, and my correspondent calls attention to the fact that they are inserted on the divisions of the perianth, well above their base, and the anthers are plainly extrorse. — ASA GRAY.

SPORES OF BLODGETTIA CONFERVOIDES. — In Harvey's Nereis Am. Bor. there is a curious figure of a plant which he called *Blodgettia confervoides,* which, if it correctly represents the fructification of the alga in question, is entirely unlike that of any other known alga. Bornet is of the opinion, from examining dried specimens, that the bodies figured as spores are parasites of some kind. Mr. F. W. Hooper, recently returned from Key West, gives the following as the result of his examination of living specimens of Blodgettia : —

"The figure of Harvey is curious indeed. To begin with the curious net-work of fibres bearing his so-called spores is, together with the spores, entirely colorless. The anastomosing fibres are made up of short cells placed end to end. The cells are about three times as long as broad. The wall of the cell is distinct and the contents colorless. It would seem, in many cases, that the so-called spores are only thin cellules swollen up, since they appear often in the middle of a filament. They are more often borne on a side branch and are often irregularly placed, looking like a miniature bunch of grapes. This whole structure is not a part of the cell-wall, but ramifies between the layers of the cell-wall. As a proof of this we have this peculiar arrangement of fibres and spores (?) continuing right through from one cell of the Blodgettia to the next. I am certain that the filaments and spores (?) have walls distinct from the layers of the cell-wall of the Blodgettia. A cross section shows this distinctly. Generally two or three layers of the cell-wall of Blodgettia separate the parasite (?) from the cavity of the cell. I can see but little reason for calling it a unicellular alga. Morphologically it suggests those Callithamnia which have seirospores." — W. G. FARLOW.

BOTANICAL PAPERS IN RECENT PERIODICALS. — *Bulletin of the Torrey Botanical Club,* May. T. L. Brandegee, List of Colorado Musci and Hepaticæ. P. J. Berckmans, in answer to a query by Dr. Thurber, states that *Acanthospermum xanthoides* and *Clerodendron Siphonanthus* were observed by him (in 1857 and 1873 respectively) in Georgia. Professor Tuckerman states that Willdenow's description of *Phaseolus multiflorus* was founded upon Cornuti's plant.

Annales des Sciences Naturelles, Botanique, VI. Sér., II. Tome, Nr. 2 et 3. P. Duchartre, Observations on the Bulbs of Lilies (2d memoir). Ch. Naudin, Irregular Variation in Hybrid Plants. Vesque, Comparative Anatomy of Bark.

Comptes Rendus, 1876, No. 14. M. Cornu, On the Spermatia of Ascomycetes, their Nature and their Physiological Role. No. 15. Boussingault, The Growth of Maize begun in an Atmosphere free from Carbonic Acid. Schnetzler, Action of Sulphide of Carbon on the Insects infesting Herbaria. No. 16. A. Trécul, On the Capillary Theory, illustrated by Amaryllidaceæ.

Flora, No. 10. Georg Winter, On some Ustilagineæ. Kraus, On the Formation of Hairs on Potato Sprouts. Geheeb, Mosses from the Mountains near the Rhone. De Krempelhuber, Brazilian Lichens. Velten, The Influence of Temperature on Protoplasmic Movements (to be hereafter noticed). Ranwenhoff, Is Horny Prosenchyma a Special Vegetable Tissue ? (Answered in the negative.)

Botanische Zeitung, No. 15. Weisner, On the Crystalline Character of the Waxy Deposit on Cuticle. Brefeld, On the Culture of certain Fungi. No. 16. Holle, On the Growth of Roots of Angiospermous Plants, with Special Reference to the Root-Cap. No. 17. Sadebeck, On the Relation of Pythium Equiseti to the Potato Fungus. No. 18. Velten, On Electricity in Plants.

ZOÖLOGY.

Another Case of Animal Commensalism. — An interesting instance of animal commensalism came to my notice recently, during the cruise of the United States ship Portsmouth among the islands of the Pacific Ocean. I found in the cloacal dilatation of the alimentary canal of a holothurian a crab belonging to a class higher in the scale of classi- ication than any that has yet been discovered possessing parasitical abits.

It is the first instance to my knowledge where a crustacean of the igh type Cancroideæ has been found living as a "free messmate" within he body of another animal. It belongs to the family Portunidæ, or wimming crabs; and it is one of those aberrant forms, or connecting inks, uniting the natatorial and the gressorial species.

It represents not only a new species, but a new genus; and Dana un- onsciously possessed the type of the genus in a little individual which e found on the coral reef at Ovolañ, Feejee Islands. He modified an lready existing genus (*Lissocarcinus* White) in order that it might re- eive his species; yet, in spite of his modification there exists almost as ide a difference between the two as between two common genera of our wn coast, *Carcinus* and *Platyonichus*, which are related in the same ay. White, in the description of his species (*Lissocarcinus polyboides*), ates that it is a powerful swimmer, with the tarsi of the posterior pair f feet broadly expanded; while in Dana's species the tarsi are flattened nd expanded in about the same proportion as in *Carcinus*, a littoral ge- us, where the lateral expansion of the tarsus of the last pair scarcely ex- eds that of the three preceding pairs.

Dana's species was a male; while the one which I found was a fe- ale. It is well known that among crustaceans it is generally the females that seek these strange places of abode, while the males live a free and roving existence; and as the general shape of the body is somewhat different in the two sexes under these circumstances, it is possible that Dana's species is the male form of the one which I discovered. In the latter the carapace or shield is less orbicular, and more produced transversely; while the shape of the claws and ambulatory feet, as well as the peculiar markings on each, are almost identical.

I propose for this little individual the suggestive generic title *Assecla;* the specific name *holothuricola* will indicate her odd place of abode. The habitat is Palmyra Island, one of the Fanning group. Dana's species belongs in the same genus under the name of *Assecla orbiculare*, unless further research should determine it to belong to the same species. — DR. THOMAS H. STREETS, U. S. N.

THE LITTLE WHITE EGRET IN COLORADO. — In Birds of the Northwest, Dr. Coues states that "the introduction of *Ardea candidissima* Gm." among the birds of the region drained by the Missouri and its tributaries "rests on its occurrence in Kansas, as recorded by Professor Snow." A specimen in fine plumage was killed and presented to me last week (May 4th), by Mr. James Sevar, of this place. It was taken on the shores of a small "lake," near the eastern base of the mountains, thirty miles northwest of Denver. The bird was a "lonely pilgrim," and had wandered far from its maritime home. — J. CLARENCE HERSEY, Boulder, Colorado.

SENSITIVENESS TO SOUND IN THE SHREW. — In the heavily-timbered forest in the neighborhood of Sheboygan, Michigan, on a cold day in October, 1875, I caught a characteristic full-grown specimen of Thompson's shrew (*Sorex Thompsonii* Baird). The pretty little creature had been busy about an old decayed stump, where it seemed to have its home. It uttered no audible cry, though at first it made several hostile demonstrations, endeavoring to escape, and, seizing my fingers in its mouth tried to bite them. but the delicacy of its teeth rendered the attempt futile. Having no suitable place in which to deposit it, I carefully wrapped it in paper, allowing its head to protrude, and held it in my hand. Some sportsmen were out shooting on the bay about a mile off, and the reports from their guns came to us from time to time, generally so much muffled by the distance as to be barely distinguishable, yet the shrew invariably responded to each detonation with a quick, spasmodic movement, evidently of alarm. Holding the animal as I did, the movement was immediately perceptible. Though aware that the acuteness of the auditory organs of these animals and their allied genera is most wonderful, I was hardly prepared for so unequivocal a proof of its extreme sensitiveness, which, under the circumstances, I was enabled to test repeatedly in this individual *Sorex.*

It was my intention to preserve the animal alive, and take it with me on my return home for further experiment and a study of its habits;

but, to my regret, on unfolding the paper while on my way to the house at which I was staying, I found the shrew had died. I have little doubt but that its death was caused by fright, as I handled it most carefully so as not to hurt it.

I found nothing of the unpleasant odor which is said to be secreted by certain glands with which this animal is provided, and which, in the form of a decided muskiness, is so apparent in the star-nosed mole. The shrew had, however. voided a slight quantity of excrement, which act, I believe, *in articulo mortis*, is common to all animals, including man.—HENRY GILLMAN.

ANTHROPOLOGY.

WESTERN WORKED FLAKES AND NEW JERSEY RUDE IMPLEMENTS.—Capt. Wm. A. Jones's Reconnaissance of Northwestern Wyoming having been received after the proof-sheets of my paper in the June NATURALIST were corrected and returned, I could not avail myself of the very interesting remarks of Professor Comstock on the archæology of that region, which in part refer to specimens such as I have described and figured in the article referred to. The implements described by Professor Comstock (Figures 40 and 41, p. 260) are evidently identical with that figured on page 331 of the NATURALIST (vol. x.). Of these western specimens Professor Comstock remarks, "It is scarcely to be supposed that these rude splinters have ever subserved the purpose of weapons or other implements, although there are many of the flakes of more definite shapes which may have been so employed. It seems probable, however, that a large proportion of those which can be referred to no particular form are merely the rejected pieces which have been spoiled during the process of manufacturing more perfect implements, or, n some cases, perhaps they are pieces from which smaller arrow-heads have been chipped." I cannot think that these specimens, at least such as those figured, are rejected or spoiled implements. The fact that the same forms occur in New Jersey, associated with others of scarcely more definite shape, and *not associated* with "smaller arrow-heads," is evidence, I claim, of their being finished implements. Again, if "failures," s it probable that there would be that uniformity in shape and size, which obtains among them? Thirdly, their outline suggests no other form of implement, such as we know; as "blocked-out" javelin heads, axes, and hatchets are well-known shapes to the collectors.

The similarity of the western specimens to fragments of rock, undoubtedly naturally formed, has suggested the possibility of all being of natural and not artificial origin. That a fragment of rock, accidentally produced, should be nearly or quite identical in outline with certain well-known forms of Indian relics, is quite natural, inasmuch as happily haped pieces of flinty stone were the first tools used by primitive man, nd suggested, in the course of centuries, the variations in shape which he increasing number and character of their wants demanded. The oldest stone implements would therefore bear most resemblance to broken pebbles, and considering the fact, that in New Jersey this western form is quite common, and so found as to place its artificial origin beyond doubt, it becomes highly probable, if not certain, that the specimens figured by Professor Comstock are traces of the former occupants of Wyoming Territory, and that, *just as they are*, they subserved some purpose as a weapon or domestic implement.

Of their antiquity I can form no opinion; but as already stated in this journal, those found in New Jersey belong to a far-distant past, and are doubtless traces of a people antedating the red man. — **Charles C. Abbott, M. D.**

WERE THE OLDEST AMERICAN PEOPLE ESKIMOS? — In regard to Dr. Abbott's paper in the June NATURALIST, in which the ground is taken that the Eskimos represent an older North American man, whom "intrusive" Indians have driven northward and replaced, the following considerations suggest themselves. This view is doubtless inspired by the efforts of anthropologists in Europe to identify boreal races like the Lapps with the pre-Aryan population of Europe. Virchow concludes that no group of older skulls yet found can be said to agree with any of the living boreal types of man. The argument rests on the character of the stone implements. Dr. Abbott seems to rely for support to the theory he adopts on the "similarity of the Delaware Valley implements to those of Europe." But there is likely to be a similarity in implements between different races, at the same stage of culture. The view that the Lapps have suffered race-degradation is interesting, if it can explain the difference existing between the older European skull and that of the modern Lapp. But although the Lapps are possibly degraded Finns, the explanation is not offered to explain the wider relationship of the boreal types existing with the older European man. So far as the implements are concerned they are then not of themselves sufficient to sustain Dr. Abbott's theory with regard to the Eskimos. The evidence from tradition, appealed to by Dr. Abbott, is hardly to be trusted. Perhaps no traditions as a class are more untrustworthy than those of the North American Indians. They had not acquired the faculty of recollecting, one may almost say. I do not think it is safe to say that it has been "demonstrated conclusively that some eighty thousand years ago the last glacial epoch came to a close," but, even so, is it safe to rely upon a tradition which refers back to an event which must have happened during a remote epoch? The question remains, Where did the intrusive Indians come from? And in regard to man do we not find first, that it is, as a rule, unsafe to speak of "autochthones," and that there has been replacement everywhere? At whatever point man may have originated, he has spread from causes acting on himself from without, such as those dependent on climate and food, and then from causes arising from his advance in intelligence; these latter movements may be called culture-migrations. Granting that the Indian replaced the older man who lived at the foot of the glacier, and that this older man is represented by the existing Eskimo, the consideration I have presented in a paper read (August, 1875) before the American Association,[1] that the migration of the Eskimos depended upon the climate of the post-glacial epoch, that they followed the ice as naturally as the butterflies and the reindeer, does not seem to me to be as yet invalidated. — A. R. GROTE.

ANTHROPOLOGICAL NEWS. — Among a large collection of Pai-Ute material received from Major J. W. Powell, at the National Museum, embracing specimens of their food, furniture of the dwelling, vessels and utensils, clothing, personal ornaments, implements, weapons, means of locomotion, pastimes, art, music, objects connected with social, civil, and religious life, some of the forms are new. A knife is of a hard, black volcanic stone, polished over its surface; the edge is beveled on both sides, and there are convenient notches for the fingers and thumb. A double bottle is similar to Peruvian forms, and there is quite a variety of these in the collection. A new method of hafting, which I have not seen figured, occurs in the case of nine axes and hammers. The head is the smooth, grooved variety, some of them having the groove all around, and others on three sides. In all cases the haft lies along one side, like a yoke on the neck of an ox, and the sinew or leather thong is *belayed* back and forward, around both haft and ax.

Near St. Georges, Southern Utah, on the Santa Clara River, Dr. Edward Palmer examined a mound about ten feet high, oval in form, nd containing about half an acre. The mound seems to have been uilt up as follows: The former inhabitants constructed small dwellings f sticks, or sticks and stones, with mud roofs. When one of their numer died, his remains, together with his apparel, implements, arms, ornaents, and vessels of food and water, were fastened up with him, and the hole consumed by fire. This is proved by the occurrence, irregularly hroughout the entire mound, of strata of ashes in the exact shape of the round plan of the house, and in the ashes the skeleton and objects deosited with the corpse. The fire-place in all can be located by a deeper yer of ashes. Subsequently earth was brought and leveled over the ot on which a new edifice was to be erected. Thus the process of acmulation went on, similar to what is exhibited on a grander scale in e city of Jerusalem and other old cities of the East.

We have a continuation of the labors of Abbé Petitot among the cKenzies River tribes in Dictionnaire de la Langue Déné Dindjie alectes Montagnais ou Chippewayan, Peaux de Lievre, et Louchaux. ibliothèque de Linguistique et d'Ethnographie Américaines. Publié r Alph. L. Pinart.

The Smithsonian Institution has received for publication an illustrated ticle upon the prehistoric mounds of Grant County, Wisconsin, by

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[1] American Journal of Science and Arts, p. 338.

Moses Strong, Assistant State Geologist. These investigations cover a portion of the State to which very little space is given in the great work of Lapham in the Smithsonian Contributions.

An event of considerable interest to anthropologists was the sale of Hon. E. G. Squier's entire library and collection of archæological specimens, on the 24th of April last.

The Archives de la Société Américaine de France, has come to hand, a pamphlet of four hundred pages, containing, in addition to the journal, etc., of the society, treatises upon the Eskimo, the Indians of the Great Interior Basin, the Californians, the Mexicans, the Mayas, the Peruvians, the Patagonians, and the Fuegans.

The Hon. Louis H. Morgan is the author of two very elaborate treatises on American Archæology. One, entitled Montezuma's Dinner, in the April number of the *North American Review*, aims to overthrow the florid descriptions of Mexican political organizations deduced from Spanish authorities by Prescott, Brasseur de Bourbourg, and latterly by H. H. Bancroft. The other is an attempt to reconstruct the ancient communal dwelling of the mound builders of the Mississippi Valley from the data of excavations as compared with the testimony of historians and the evidence of the modern Pueblos.

The following European journals, devoted to anthropological investigations, can receive a brief mention only. *Journal of the Anthropological Institute*, No. 15, April, 1876, contains papers on the Bhutas, on the International Symbols, on Rhabdomancy and Belomancy, on the Maories, and on Kitchen Middens in California.

Revue d'Anthropologie, 1876, No. 1, in addition to the usual amount of valuable critical matter and bibliography, contains original papers on the Gorilla, on the Brains of Idiots, on Stature, and on the Avares of Daghestan.

No. 3 of *Matériaux pour l'Histoire Primitive et Naturelle de l'Homme* is a very interesting number. The following subjects are treated: The Ossiferous Cavern of Kesserlock at Thayngen, near Schaffhausen; Sepulture of the Lacustrian Populations of Lake Neuchatel. (A short critique of this work is accompanied by full lists of tertiary diggings, quaternary diggings, surface finds, and cave finds.) Le Dictionnaire Archéologique de la Gaule. Reviews are given upon several recent anthropological treatises. The article on lacustrian sepulture is based upon the discovery of a tomb in excavating the foundation of a house near the remains of a pile-dwelling on the borders of Lake Neuchatel, between Auvernier and Columbier. The dead were inclosed in cists, several corpses in one grave interred from time to time. This sepulchre seems to have been in the transition period between the neolithic and bronze ages, because we have in the same cist rude, bronze burial deposits and uncremated bones. The further exploration of this find is expected to yield useful results.

The most interesting communication in No. 3 of *Correspondenz Blatt* is the one by Herr von Seebach, on the hitherto discovered fossil Apes and their Relation to Mankind.

Archivio per l'Antropologia, with the exception of an original memoir upon the Anthropology of Idiots, is devoted entirely to matters of special interest to Italian anthropologists. The following special treatises may be of interest to the readers of the NATURALIST: —

Zur Kentniss der Wirkung der Skoliopædie des Schädels, A. Ecker, Braunschweig, 1876. The Descriptive Catalogue of the Musical Instruments in the South Kensington Museum, C. Engel. Das Salz. Dr. M. J. Schleiden, Leipzig. The Races of Mankind and their Civilization. E. B. Tylor, before the London Institution, March 23, 1876. L'Anthropologie, P. Topinard, Paris, 1876, 1 vol. 12mo, pp. xiv., 574. Die Altesten Feurzeuge, Dr. O. Brichner, Gæa, iii., 1876.

Revue Scientifique of April 1, 1876, gives an extended account of the discovery of an ossiferous cave of the polished stone age at Belfort, near Cravanche, France. The cave belongs to the Jurassic period. The floor is covered with stalagmites, to which no stalactites correspond, and they are arranged in a certain definite order, like series of cromlechs. The bones are found in the depressions between the stalagmites encased in the calcareous matter. This discovery is especially valuable, because few sepulchres of the polished-stone age have been found as yet in Europe.

The *Journal of the Anthropological Institute* for April, 1876, in addition to articles already reported in this magazine, has a complete index of all the papers in the following publications: *Journal of the Anthropological Institute* previous to the current number; *Journal and Transactions of the Ethnological Society; Memoirs of the Anthropological Society of London.* The Smithsonian Institution is preparing a full index of all its publications, classified by subjects.

Le Compte Rendu de la Première Session du Congrés International des Américanistes, published at Paris under the editorship of Maisonneuve & Cie., comprises two octavo volumes of nearly four hundred pages each. In addition to the constitution and rules of the Société Américaine de France, the rules of the International Congress, and the list of delegates, these volumes contain nearly all the papers read at the meeting in Nancy. A wide field of discussion is covered, embracing essays upon the Phœnicians, Buddhists, Fou-Sang, the lost Atlantis, the voyages of the Northmen, and the discoveries of the fifteenth and sixteenth centuries; upon the tribal characteristics, manners, and customs, cults, migrations, and languages of the various tribes; and upon the antiquities of both continents. Although much of the discussion is speculative or even fanciful, much of it is very profitable reading, and we do not hesitate to affirm that the study of aboriginal American history was really promoted.

M. de Mainof, secretary of the ethnographical section of the Russian Geographical Society, has announced to the society that he is preparing a complete treatise on Russian Ethnography. It will appear in parts, each containing a description of one section of the people.

The April number of *Matériaux* contains a review of Italian prehistoric bibliography, for 1875; Studies on the Megalithic Monuments of the Valley of the Ouse; Superposition of the Solutréan upon the Moustieran at Thorigne (Mayenne); The Lacustrian Tombs of Auvernier, and an illustrated article by A. L. Lewis, upon the construction of Megalithic Monuments in India. Those who have sought for a rational theory of the manner in which such masses of stone were erected by uncivilized peoples in Europe, will find a plausible explanation here.

The Rhind Lectureship in Archæology, in connection with the Society of Antiquaries of Scotland, founded by a bequest of the late Alexander Henry Rhind, of Sibster, was filled during the last season by Dr. Arthur Mitchell, joint secretary of the society, upon the question, "Do we possess the means of determining scientifically the condition of primeval man and his age upon the earth?" In consequence of a great many coexistences of high and low culture in the same locality, and the immense changes known to have been wrought within the space of even a century, the author comes to the following conclusions:—

(1.) That the very rudest known form of any art may coexist in a nation with the highest.

(2.) That it would be wrong to conclude from this that the nation must be composed part of civilized and part of savage people.

(3.) That persons capable of receiving the highest culture might practice an art which belonged to the most palæolithic people. — O. T. MASON.

GEOLOGY AND PALÆONTOLOGY.

RECENT DISCOVERIES OF EXTINCT ANIMALS BY PROFESSOR MARSH. — In a lecture to the graduating class of Yale College, delivered in the new Peabody Museum, June 3d, Professor O. C. Marsh gave a brief *résumé* of the more important results of his late palæontological researches in the Rocky Mountain region. His explorations, which were attended with much hardship and danger, have been mainly confined to the Cretaceous and Tertiary formations, and especially to the vertebrate fauna. During the past six years, the expeditions under his charge have brought to light more than three hundred species of fossil vertebrates new to science, about two hundred of which he has already described.

Among the extinct animals thus discovered, were many new groups, representing forms of life hitherto unknown. The most interesting of these are the Cretaceous *Odontornithes*, or birds with teeth, which constitute a new sub-class, containing two distinct orders, namely, the *Odontolcæ*, which have the teeth in grooves, and the *Odontotormæ*, with teeth in distinct sockets. The former were swimming birds of gigantic size, with rudimentary wings, and the vertebræ as in modern birds. The type genus is *Hesperornis*, and three species are known. The second order embraces at present only small birds with powerful wings, and biconcave vertebræ. The type genus is *Ichthyornis*, and the geological horizon is upper Cretaceous. Another discovery of importance from the same formation was pterodactyls, or flying reptiles, the first detected in this country. These are of much interest, on account of their enormous size,—some having a spread of wings of more than twenty-five feet,—but especially as they were destitute of teeth, and hence resemble recent birds. They form a new order *Pteranodontia*, from the typical genus *Pteranodon*, six species of which are now known. With these fossils were found large numbers of Mosasauroid reptiles, and remains of more than five hundred different individuals were collected. These proved to belong to two new families, *Tylosauridæ* and *Edestosauridæ*. Some of the former attained a length of sixty feet, while the latter were much shorter, the smallest being less than ten feet. These groups included several new genera and many species. This large series of specimens enabled Professor Marsh to clear up many doubtful points in the structure of these reptiles, and to determine that they possessed hind paddles, and were covered, in part at least, with bony dermal scutes. Many other birds, reptiles, and fishes were found in the same Cretaceous strata.

The discoveries of Professor Marsh and party in the Tertiary of the West were of no less importance. The most interesting are those made in the two Eocene lake-basins between the Rocky Mountains and the Wahsatch Range. These basins were explored by Professor Marsh in 1870, and their Eocene age then first determined. His explorations in this region have secured to science over one hundred and fifty species of new vertebrates, most of them widely different from any hitherto known. The most remarkable of these are the gigantic mammals of the new order *Dinocerata*, the type genus of which is *Dinoceras*. These animals nearly equaled the elephant in size, but the limbs were shorter. The skull was armed with two or more pairs of horn-cores, and with enormous canine tusks, similar to those of the walrus. The brain was proportionally smaller than in any other land mammal. Three genera and several species are known. Remains of more than one hundred distinct individuals were obtained, and are now in the Yale Museum. The *Tillodontia* are another new order of mammals discovered in the same Eocene deposits. They possess many remarkable characters, which indicate affinities with the Carnivores, Rodents, and Ungulates. There are two well-marked families, the *Tillotheridæ*, from the typical genus *Tillotherium*, which has rodent-like incisors; and the *Stylinodontidæ*, in which all the teeth grew from persistent pulps. The largest of these peculiar animals was about the size of a tapir. One of the most interesting discoveries made by Professor Marsh in the Eocene of Wyoming was the remains of Quadrumana, the first found in the strata of America.

These early Primates appear to be related both to the lemurs of the Old World, and to some of the South American monkeys. Two families are known, the *Lemuravidæ*, from *Lemuravus*, the principal genus, which has forty-four teeth, and the *Limnotheridæ*, which have not more than forty. The latter group is rich in genera and species. Among the other Eocene mammals discovered were marsupials and bats, not before known in a fossil state in this country. One of the most important Eocene mammals found was a small ungulate, which is the oldest probable ancestor of the horse. It was about as large as a fox, and had four toes before and three behind. The genus was named *Orohippus*, and several species were discovered. These remains, in connection with others from the later tertiary, enabled Professor Marsh to trace the line of descent which has apparently produced the modern horse. In addition to the Eocene mammals, many species of birds, serpents, lizards, and other vertebrates were collected.

The discoveries made by the same expeditions in the Miocene and Pliocene lake-basins of the Rocky Mountains and Pacific coast were likewise very numerous, and many new forms of animal life were brought to light. One group of mammals found in the early Miocene of Oregon is allied to the modern *Rhinoceros*, but differs in having a transverse pair of horn-cores on the nasal bones. The genus was called *Diceratherium*, and one of its species is the oldest known member of the Rhinoceros family, if not its progenitor. The most remarkable mammals found in the Miocene were the huge *Brontotheridæ*, which are apparently allied both to the above group and to the Eocene *Dinocerata*. They equaled the latter in size, and also had an elevated pair of horn-cores on the maxillary bones. One genus of this family was previously known by a few imperfect specimens. Besides *Brontotherium*, several other new genera of this group were found, represented by portions of over two hundred individuals. With these remains was discovered a genus of small equines, *Mesohippus*, about as large as a sheep, and having three toes on each foot, with an additional "splint" bone on those in front, thus forming an interesting Miocene link in the genealogy of the horse, completed by the Pliocene genera. Over thirty species of fossil horses were collected in these formations. Among the interesting animals obtained in the Pliocene deposits were two species of large Edentates, the first tertiary representatives of this order from America. They belong to a new genus, *Morotherium*. There were also found large numbers of rhinoceroses, camels, Suillines, and other mammals, as well as many birds, reptiles, and fishes.

A study of the large series of extinct animals thus collected, and now in the Yale Museum, promises to throw much light on the development of life on this continent, and Professor Marsh has already drawn from them some important principles. One of these relates to the size and growth of the brain in mammals, from the beginning of the Tertiary to the present time. The conclusions reached may be briefly stated as follows: *First*, all tertiary mammals had small brains; *second*, there was a gradual increase in the size of the brain during this period; *third*, this increase was mainly confined to the cerebral hemispheres, or higher portion of the brain; *fourth*, in some groups, the convolutions of the brain have gradually become more complicated; *fifth*, in some, the cerebellum and olfactory lobes have even diminished in size. There is some evidence that the same general law of brain-growth holds good for birds and reptiles from the Cretaceous to the present time.

Some additional conclusions in regard to American Tertiary mammals, so far as now known, are as follows: *First*, all the *Ungulata* from the Eocene and Miocene had upper and lower incisors; *second*, all Eocene and Miocene mammals had separate scaphoid and lunar bones; *third*, all mammals from these formations had separate metapodial bones.

In conclusion, Professor Marsh stated that his work in the field was now essentially completed, and that all the fossil remains collected, and in part described, were now in the Yale College Museum. In future, he should devote himself to their study and full description; and hoped at no distant day to make public the complete results.

EXTINCT CORAL REEF AT BAHIA. — The Geological Commission of Brazil has just been examining with a great deal of interest, in the Bay of Bahia, an extinct reef, which would need little more than an intermingling with geological strata to make it resemble some of the limestone formations of the United States. Opposite the city of Bahia is the large and long island of Itaparica, which extends in nearly a northeast and southwest direction. It is formed of *cretaceous* rocks which appear along a large portion of the shore, and, outcropping underneath the water, afford good foundations for coral growth. The reef we have just mentioned is a fringing one, extending along the middle part of the southeast side of the island, for a distance of about eight nautical miles, and distant from the shore from one eighth to one quarter of a mile. It apparently follows a line of outcrop of cretaceous sandstone, and is made up mainly of a few species of corals and of nullipores, the latter form seeming to contribute the greatest amount of material to the reef. Running along the reef, we find that it varies in width from sixty to nearly two hundred feet; at extreme low tide its height above the water is about four and one half feet, and this height does not vary much throughout its entire length. At high water the reef is covered by the sea, which almost constantly breaks upon it, and, as the entire reef faces the ocean, in times of storm a heavy line of breakers is formed outside of the shore. Then, even at low tide, the sea often breaks entirely over the reef and makes an examination dangerous. There are numerous openings, or *barras*, through which small boats can enter and find a safe harbor within. At the southern end it becomes broken up and lies in detached portions. The reef has sometimes a single elevation above low water, at other times two; where there is one, it is broad and quite level, with only slight irregularities, often broken into by pools and short channels; where there are two, the lower, which has a varying height, is broad, resembling the above, and near the outer edge it rises into a narrow upper level, very irregular and generally covered with barnacles. These two series graduate into one another. The outer edge of the reef, after rather a rapid descent from the higher levels, descends gradually under the water, but the sea has been so rough the past month as to prevent an examination far down. The inner edge is quite abrupt, descending thus to the bottom, and generally has numerous outliers. The total height of the reef above the bottom inside, is only about seven to ten feet, and often very much less from an accumulation of material there. In breaking into the upper part we always find a simple nullipore growth, layer upon layer, and so compact and hard as to often break the edge of the chisel broadly off in vain endeavors. In the lower levels we find huge heads of *Acanthastræa Braziliensis*, and more rarely *Heliastræa aperta*. *Siderastræa stellata* is abundant, and generally of large size. We also find some immense growths of *Millepora*, but even here the *Nulliporas* are the most common. The outer coating of the reef is of a brown color and all looks alike from the dead encrusting nullipores. What is the life of the reef? Only a few boring animals, now and then a specimen of *Symphyllia Harttii*, *Siderastræa stellata*, or a small *Favia* in the tide or open pools. Sea-weeds are very abundant, and there is generally a rich nullipore growth on the outer edge of the reef, for a short distance above low-tide level. We know from the raised beaches, that the shores around the bay have all been elevated at rather a late period, and the reef was undoubtedly raised at the same time. Thus the destruction of the life. It would seem as though the reef had been a coral one, but coming into the action of the waves, only nullipores could grow, and not a single coral exists in the upper portion. The bottom inside of the reef has a thick bed of fragments of the same corals we mentioned above, and in addition immense numbers of the fragments of *Mussa Harttii*, which has not yet been found alive in the bay of Bahia. This deposit is more or less consolidated, and the material composing it must have been broken from the reef during the period of its elevation. Then probably all the more fragile portions were swept inward by the waves to form this broad layer, which consists most largely of *Millepora* and *Nullipora*. The former must have been dead ere it was broken off, as the specimens are generally covered over above with a coating of *Nullipora*. — R. RATHBUN.

GEOGRAPHY AND EXPLORATION.

Cameron's Discoveries in Africa. — Lieutenant Cameron gave an account of his walk from Lake Tanganyika to the west coast of the continent, at a meeting of the Royal Geographical Society, held April 11th. He said, according to the *Geographical Magazine* for May, that most of the country from the Tanganyika to the west coast is one of almost unspeakable richness. There are metals, iron, copper, silver, and gold; coal also is found; vegetable products, palm-oil, cotton, nutmegs, several sorts of pepper and coffee, all growing wild. The people cultivate several other oil-producing plants, such as ground-nuts and *seni seni.* The Arabs, as far as they have come, have introduced rice, wheat, onions, and a few fruit-trees, all of which seem to flourish well. The countries of Bihé and Bailunda are sufficiently high above the sea to be admirably adapted for European occupation, and would produce whatever may be grown in the south of Europe. The oranges which Señor Gonsalves had planted at Bihé, where he had been settled for over thirty years, were finer than any I had ever seen in Spain or Italy. He also had roses and grapes growing in luxuriance.

The main point of the discoveries I made, I believe to be the connection of the Tanganyika with the Congo system. The Lukuga runs out of the Tanganyika, and there is no place to which it can run but to the Luvwa, which it joins at a short distance below Lake Moero. The levels I have taken prove most conclusively that it can have nothing whatever to do with the Nile; the river at Nyangwé being between 1400 and 1500 feet above the sea, while Gondokoro is over 1600 feet. And also in the dry season the flow of the Lualaba is about 126,000 cubic feet per second; that of the Ganges, which is far larger than the Nile, being not more than 80,000 cubic feet per second in flood-time, and that of the Nile at Gondokoro, below where all the streams unite, is between 40,000 and 50,000 feet per second. Many large rivers flow into the Lualaba below Nyangwé.

There is in the centre of Africa a water-system which might be utilized for commerce, which has no equal upon the face of the globe. Between the large affluents of the Congo and the head-waters of the Zambesi, a canal of between twenty and thirty miles across a level, sandy plain, would join the two systems, and the River Chambezi, which may be accepted as the head stream of the Congo, ought to be navigable to within two hundred miles of the north of Lake Nyassa. To the eastward of Lovate ivory is marvelously plentiful.

The blot upon this fair country is the continuance of the slave trade, which is carried on to a great extent, to supply those countries which have already had their population depleted by the old coast trade. The chiefs, like Kasongo and Meta Yafa, are utterly and entirely irresponsible, and would give a man leave, for the present of two or three guns, to go and destroy as many villages, and catch as many people as he could for slaves. The Warua, especially, although holders of slaves, would rather die than be slaves themselves. I have heard instances of their being taken even as far as the Island of Zanzibar, and then making their way back, single-handed, to their own country. The only thing that will do away with slavery is opening up Africa to legitimate commerce, and this can be best done by utilizing the magnificent water-systems of the rivers of the interior.

MICROSCOPY.[1]

WYTHE'S ILLUMINATOR. — Dr. J. H. Wythe recommends for oblique illumination a right-angled prism with a plano-convex lens, cemented to and covering one of its narrow sides, and an ordinary French triplet fastened to the other, close to the farthest angle. Arranged with the plano-convex lens directly downward, the axis of the triplet would be horizontal, and a horizontal cone of achromatic light would be furnished; while by slightly tilting the apparatus an available and extremely oblique illumination is obtained.

SAN FRANCISCO SOCIETY. — At the annual reception of this society, twenty-two members exhibited a large number of objects from the mineral, vegetable, and animal kingdoms. The intelligent classification of the views was a notable improvement upon the management of too many exhibitions of this kind.

BLIVEN'S PHOTOGRAPHS. — Mr. R. H. Bliven, of Elmore, Ohio, is now supplying good photographs of a large variety of objects. He also makes to order photographs of any suitable slide. Such pictures of familiar objects are very interesting. They are doubly important if the slides are particularly choice or rare, as a partial protection in case of accident to the objects themselves; while for educational purposes they are often available under circumstances where a resort to the microscope itself would cause too much interruption or delay.

APERTURE OF AN OBJECTIVE. — [Mr. Tolles contributes the following note in regard to the aperture of an objective marked 180°, which was sent to London some years ago, and has been the object of no little discussion ever since.]

The diameter of the exposed front surface of an immersion objective, is given as .043″, the point of focus as obtained by using only the rays emerging from the front, comparatively near to the axis, = .013″, and a diagram is given (Figure 25), as conclusive against any more than 118° of air-angle in the objective. But the objective was marked 180° of air-angle. A year afterwards the author of the diagram, Mr. Wenham, communicates another item relating to the angular aperture of the same lens. He gives

FIG. 25.

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[1] This department is conducted by DR. R. H. WARD, Troy, N. Y.

the greatest thickness of glass cover which it would work through as .018″, and I will supply the triangle, (Figure 26) to suit the new distance in glass.

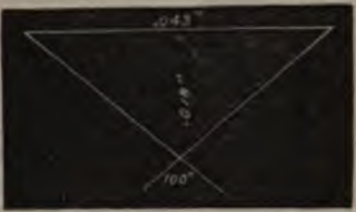

Fig. 26.

Measured by the outside lines, we have here a balsam angle of 100°. But the whole opening of the front face of an objective of quite moderate power, even, is seldom used. Accordingly, nearly a year of interval again having elapsed, he gives the utilized aperture of the front lens, front surface, as .033″. The triangle thus becomes as the dotted lines make it in (Figure 27), which I contribute to the argument. It shows 180° inevitable for a dry mount, or as closely to that incidence = 90° of obliquity as can be practically considered, and the difference between 82° and 88° clearly an increase for balsam mounts over what a dry lens can have.

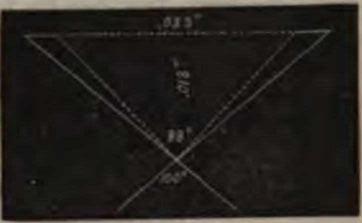

Fig. 27.

The fact is that the ray emerging into air at the extremest distance from the axis for the in-air utilized area, hugs the surface of the lens, traversing the air parallel to it. — R. B. Tolles, Boston, May 5, 1876.

Oxalate of Asparagine. — Mr. C. C. Merriman's slides are prepared from saturated solutions of asparagine and oxalic acid, and solution of gum-arabic, about in the proportions of five, four, and three parts of each respectively. The solutions are mixed only in small quantities for immediate use, and the proportion varied according to the effect produced. When dry the specimens are protected by a thin film of collodion before mounting in old balsam.

Action of Poison on Blood. — Dr. Blake found that one grain of sulphate of thorium injected into the blood vessels of a rabbit caused death in two minutes, after which the blood-corpuscles, having entirely lost their natural form, presented an indented outline with numerous highly refracting dots at the circumference.

Exchanges. — [Notices not exceeding four lines in length, of microscopical objects, or apparatus wanted or offered in exchange, not sale, will be inserted in this column without expense.]

Seeds of *Paulownia imperialis*, in exchange for other good objects. — H. S. Moore, Sixth Avenue, corner 43d Street, New York.

A large variety of objects, in exchange for any good slides. Lists furnished on application. — W. G. Corthell, 103 Warren Avenue, Boston, Mass.

Well mounted and named slides wanted in exchange for cabinet-size photographs of the objects. — R. H. Bliven, Elmore, Ohio.

SCIENTIFIC NEWS.

— Professor Henry took the opportunity at the last meeting of the National Academy of Sciences, to say a few words about the Smithsonian Institution. Its fund at present, having been increased by donations and judicious management, amounts to $717,000, although $600,000 has been expended on the building, and the original legacy produced only $541,000. Congress has enacted several liberal measures which have been of great service to the Institution and have relieved it of many expenses, such as the cost of caring for the grounds and library; and latterly an appropriation of $20,000 per year has cleared the expense of the National Museum. This liberality has enabled the Smithsonian to devote a larger share of its income toward publishing works of original research, and to defray the expense of its system of scientific exchanges, which has the whole world for its field. The publications already issued and under way were enumerated. Professor Henry said that it was contemplated to authorize a series of experiments to determine accurately the rate of increase of the earth's temperature at progressive depths. This was now rendered more practicable than before by the number of artesian wells in the country. Another project included new and careful experiments on the velocity of light; that furnishing one of the means for ascertaining the distance of the sun. Some steps had been taken to carry out this project, and a gentleman had promised to give a special fund for the purpose. The work of obtaining accurately the weight of the earth by the method devised by Cavendish would also probably be undertaken anew, there being at the present day better means for this purpose than those of the old experiments. Professor Henry alluded to his own advancing years and his anxiety to have the Smithsonian in a position of permanent security before the close of his life. The accumulations of the museum already overstock the building, and when the collections that have been sent to Philadelphia are returned, there will be no room for them. Conversing on the subject with a prominent member of Congress, he had recently stated his firm conviction that the problem could best be solved by abandoning the present building to the National Museum and erecting a new structure, to cost $100,000. The new building could be adapted solely to the needs of the Smithsonian in its proper work, and should contain besides accommodations for the system of exchange a chemical, a physical, and a biological laboratory with a lecture-room. — *N. Y. Tribune.*

— The Exeter Natural History Society was organized December 7, 1874, with the following board of officers, who still hold their positions: President, Rev. Benjamin F. McDaniel; Vice-Presidents, A. C. Perkins, Miss H. E. Paine; Secretary, William H. Gorham, M. D.; Treasurer, Charles Burley. It has a membership of between forty and fifty, and has a museum and a library, still small, but rapidly growing. Meetings are held once a month, at which essays are read or topics of natural science discussed. At the society's rooms free popular lectures are given weekly. The society would be very grateful for any assistance rendered by individuals or older societies in enlarging its museum and library.

— Dr. Günther exhibited, at a late meeting of the Zoölogical Society of London, a male, female, and young specimens of a minute Australian animal (*Antechinus minutissimus*), which may be regarded as a marsupial shrew mouse; it is the smallest known Australian mammal. The female was remarkable as having seven young in the marsupium and only four mammæ.

— A number of undergraduates in the Tennessee Agricultural College of East Tennessee University, at Knoxville, have organized a science club, which meets fortnightly. The club promises to become a useful agent in diffusing an interest in the study of natural history throughout the college. At present the most popular subjects with the members of the club are entomology and botany, in both of which collections have been begun.

— Mr. Darwin is engaged upon a work on the comparative results of the cross-fertilization and self-fertilization of plants.

— The Harvard College Summer School of Geology, under the direction of Prof. N. S. Shaler, director of the Geological Survey of Kentucky, will afford geological students an opportunity of working over the area extending from the Cumberland Mountain to the Black Mountains of North Carolina, a region rich in geological, botanical, zoölogical, and archæological interest. We have received the final directions for the guidance of students of the school, which gives full details as to the expenses of the trip to Cumberland Gap, and the mode of reaching the camp. The tickets from Boston and return will be $44, the admission fee $50, including wagons, tents, and instruction. Board will be $5 a week. This is a favorable opportunity for other than geological students to travel in an inexpensive way through one of the most interesting mountain regions in the country.

— The work of the Geological Survey of Brazil is now being carried n by Professor Hartt in the interior; not being in direct communicaion with Rio Janeiro, letters and parcels should be sent to the secretary f the survey, Major O. C. James, Caixa no Correlo, No. 126, Rio de aneiro, Brazil.

PROCEEDINGS OF SOCIETIES.

National Academy of Sciences. — April 18-20. Mr. L. H. Morgan began his paper entitled A Conjectural Restoration of a Pueblo f the Mound Builders, with the remark that "a conjecture is somemes worth the time spent upon it." It is necessary first to consider carefully some practices and usages of the aborigines which were general among them over wide areas. We find that in all parts of America they usually constructed what may be called joint-tenement houses. We find these houses occupied by a number of related families. They practiced communism in living. The marriage relation was simply pairing. They also followed certain customs, which may be designated as the law of hospitality. The land was owned in common by families and households. Those that had fully reached this method of living have been called Village Indians. Mr. Morgan thinks that the Mound Builders were probably Village Indians from New Mexico. Their arts as shown by their implements, their copper tools, their textile and fictile fabrics, were in advance of the Indian tribes found east of the Mississippi.

We find in Yucatan and Chiapas the highest type of Village Indian life. It declines as we advance northward to Mexico and New Mexico. It was best adapted to a warm climate. The attempt to transplant this mode of life from the Rio Grande or the San Juan, first to the Gulf of Mexico and then northward to the Ohio, must have been a doubtful experiment from the start. Nevertheless, the structures left by the Mound Builders indicate such an attempt; their earthworks may be regarded as the dwelling sites of Village Indians. It is certain that if a sensible use for these embankments can be discovered, the mystery about them will be dispelled. The theory that they were built for religious purposes is exceedingly improbable; the magnitude of the works, considering their grade in civilization, indicates that these Indians were laboring for themselves, not for their gods. If a tribe of Village Indians, with their acquired habits of living, emigrated to the valley of the Ohio, they would find it impossible to construct adobe houses. Some modification of the plan and character of the house would be necessary, because of the difference of climate. They might have used stone, but they did not; no stone houses had been built by these tribes. They might have made a house of inferior character upon the level ground, like the timber-framed houses of the Minnitarees. Lastly, they might have raised embankments of earth and built houses on their summits; and this, it is respectfully submitted, is what they did.

The elevated platform is a feature of the adobe houses of New Mexico; it appears also in the Yucatan dwellings. Let us regard the high bank-works on the Scioto River as a pueblo. It is an octagonal inclosure of nine hundred feet square, with an opening at each angle and in the centre of each side. The embankments are now fifty feet thick at the base, and ten or eleven feet high. If reformed with their own materials, they would produce embankments like a railway grade, thirty-seven feet wide at the base, ten feet high, and with summit platforms twenty-two feet wide. These, then, were the sites of their houses. There are six of these embankments, each four hundred and fifty feet long, and one of nine hundred feet. On the inside, before each opening, there is a mound. If the openings were gateways defended by palisades, the whole structure became a fortress. We have now to suppose that the buildings were of timber, on the summits of the embankments, and uniform with the latter in slope. The walls of the buildings were coated with earth, and probably rose ten or twelve feet above the embankments, thus making a continuous sloping rampart twenty feet high. This form of house would harmonize with the prevailing architecture of the Village Indians; but a knowledge of the actual shape of the houses or of their interior arrangements, is not necessary to the hypothesis. The Minnitaree and Mandan Indians surround their houses with a wall of split timber, coated with earth. It may be pointed out that such structures on the edge of embankments could not be successfully assailed from without, either by Indian weapons or by fire.

Mr. Morgan exhibited a ground plan for such buildings, showing how they might have been readily constructed, and would perhaps contain from two to three hundred families, on the communal plan, and serving the purposes of their former mode of life. In fact, the mode of life necessarily determined the form of architecture. We need not discuss the uses or objects of the inclosure formed by the circular embankments. It is not improbable that it was the Village garden. But this mode of life was after all not adapted to the climate, and these emigrants eventu ally succumbed in the struggle for existence. There is evidence of the better adaptation of such a life to warmer climates, from the fact of the longer continuance of the Village Indians in Mexico, and especially in Central America.

Major Powell has long made Indian structures a study. He mentioned that several of his observations indicated that where tribes had made an advance in civilization, their tendency was toward the communal or pueblo form of buildings; this is indicated by the comparative age of the ruins, the most ancient not being inclosed at all, while the latest were surrounded by cliffs or walls. The age is determined chiefly by the thickness of the covering *débris*. Major Powell is inclined to believe that many of the cliff houses were built for refuge during the Spanish invasion, and such is the tradition among the Indians. Among some of the Utes the land of existence after death is placed beyond the mountains; but among the Pueblos heaven is an architectural affair; it is in the second or third story.

Professor Marsh approved the conclusions of Mr. Morgan, and brought fresh evidence to support them from an entirely different source. In a long series of comparisons of Indian skulls, Professor Marsh has been much struck by the similarity between those of the Pueblo Indians and of the Mound Builders. As the shape of the Mound Builder's skull is very peculiar, the coincidence is a very striking one. Professor Newberry added a few remarks about the buildings on the table lands, which he said were possibly six hundred or seven hundred years old, while trees growing over the skeletons of the Mound Builders had been ingeniously shown by General Harrison to indicate an antiquity of not less than eight hundred years.

Boston Society of Natural History. — April 5th. Prof. A. Hyatt read a paper on The Relations between the Commercial Sponges of the Mediterranean and Caribbean Seas.

April 19th. Dr. B. Joy Jeffries remarked on Muscular Action associated with Vision.

SCIENTIFIC SERIALS.[1]

Monthly Microscopical Journal. — May. Note on the Markings of *Navicula rhomboides*, by J. J. Woodward. Some Results of a Microscopical Study of the Belgian Plutonic Rocks, by A. Rénard. A New Microscopic Slide, by E. Vanden Broeck. Measurements of Möller's Diatomacean Probe Platten, by E. W. Morley. — June. On the Markings of the Body-scales of the English Gnat and the American Mosquito, by J. J. Woodward. Remarks on *Frustulia saxonica*, *Navicula rhomboides*, and *N. crassinervis*, by Charles Stodder. On the Measurement of the Angular Apertures of Object-Glasses, by Jabez Hogg.

The Geographical Magazine. — May. The Arctic Expedition, vii. Prospects for the Campaign of 1876. The Island of Sokotra. Ferghana. New Maps of Mongolia.

Proceedings of the Royal Geographical Society, London. — February 23d. Lieutenant Cameron's Arrival at the West Coast of Africa. Letters detailing the Journey of the Livingstone East Coast Expedition from Lake Tanganyika to the West Coast of Africa. Stanley's Letters on his Journey to Victoria Nyanza and Circumnavigation of the Lake. Note on the Height of the Victoria Nyanza, by C. George. April 7th. Captain the Hon. G. Napier's Journey on the Turcoman Frontier of Persia, by F. Goldzmid. Extracts from Mr. Margary's Diary.

Canadian Naturalist, vol. viii., No. 2. On the Nipigon or Copper-Bearing Rocks of Lake Superior, etc., by J. W. Spencer. Notes upon the Superficial Deposits of Ontario, by D. F. H. Wilkins. New and Interesting Insects from the Carboniferous of Cape Breton, by S. H. Scudder. On the Mollusca of the Post-Pliocene Formation in Acadia, by G. F. Matthew.

The Geological Magazine. — June. The Vertical Range of Graptolites in Sweden, by G. Linnarsson. Correlation of the Graptolitic Deposits of Sweden with those of Britain, by H. A. Nicholson.

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[1] The articles enumerated under this head will be for the most part selected.

THE

AMERICAN NATURALIST.

Vol. x. — AUGUST, 1876. — No. 8.

THE ANCIENT POTTERY OF COLORADO, UTAH, ARIZONA, AND NEW MEXICO.

BY EDWIN A. BARBER.

FOR the purpose of exploring a comparatively unknown tract of country on the Pacific slope, in the far Southwest, supposed to abound in architectural remains of the ancient Pueblo race, a portion of the United States Geological Survey, in charge of Professor F. V. Hayden, was dispatched across the Rocky Mountains during the summer of 1875.

Over this vast extent of territory, covering probably two hundred thousand square miles, are strewn great quantities of broken pottery, which have lain exposed to the atmosphere for many centuries, and are still, for the most part, in a state of good preservation. So perfect, indeed, are many of the specimens, that they appear as though they had been molded and shattered to pieces but yesterday. This earthenware occurs most abundantly in the vicinity of ruins, where it often lies so thickly as to suggest the idea, which some archæologists entertain, that such places had once been the sites of huge potteries, where the ware had been manufactured on a wholesale plan. Upon a superficial observation I at first entertained this opinion, but after more careful and extensive investigations I discovered this to be erroneous. When we consider the fact that tons of this fragmentary crockery are scattered over hundreds of miles of this *mesa* country, it would seem as if some method had been employed for turning out great numbers of vessels by the agency of machinery; yet we ascertain that this was not the case, but that each piece had been fashioned by the hands of the *work-women*, and it seems highly probable that the inmates of each ancient household were their own potters. The employment of the plastic art was such a universal necessity that every family over this broad land con-

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tained one or more skillful artificers. In the seven Moqui Pueblos of Arizona, I was fortunate enough to witness the modern operation as performed by the women of the tribe, and I doubt not that the method is very similar to the ancient. The vessel was first molded out of the plastic yellow clay, and, whether painted or not, was placed when dry in a small square aperture or oven, built in the side of the stone wall of the dwelling. There it was burnt until done; and I noticed in or near each of the Moqui houses several of these baking kilns, which were as important a part of the household as the fire-place or the ever-present flour-mill.

Around the bases of the mesas beneath the villages lay great quantities of damaged pottery, which had been accumulating for many years, perhaps centuries. Each vessel, as it outlived its usefulness, was cast over the bluff to swell the heap below. Thus among the ruins, we noticed in the walls of many of the structures square or cubical apartments in the solid walls, about eighteen inches in dimension, which had without doubt served the purpose of bake-ovens. It is not unreasonable to suppose, then, that every family produced its own utensils, and that in the course of a few years a considerable amount of rejected ware collected in the vicinity of each occupied building. In the immediate neighborhood of each house, be it large or small, this pottery abounds in greater or lesser quantity, so that were we to suppose one ruin or one locality to have once constituted a burning kiln, we must class all the structures under the same head.

As the result of a particular study of a great variety of specimens which we were unable to bring away, and also a subsequent examination of our own extensive collections, I have divided the ancient earthen ware of this region into five classes, namely: —

I. The plain burned clay.
II. The laminated or indented.
III. The embossed or molded.
IV. The glazed ware.
  1. *a*. Plain white.
    b. Ornamented in
  2. Red or brick-wa
V. The glazed and

I. This include
tery, made of

II. The

or lines were marked out, they were pressed down symmetrically with the thumb of the maker, as we find much of this species of ware which exhibits the impress of the human thumb, the very minute lines of the cuticle being distinctly visible. Lieutenant Whipple advances the suggestion that this has been done by the pressure of a small shell, whose delicate lines have been retained in impression upon the exterior of the material after it has been hardened. But it can be readily seen how much more rapidly this ornamentation could be effected by the use of the thumb and fingers. In some varieties of this class of pottery, the plain surface of the vessel is covered by winding long strips of plastic clay around spirally, one edge of each whorl overlapping the next, and this is ornamented according to the taste of the maker. The most common method, however, is marking the surface off into pointed scales as described previously.

Captain Moss, who has lived among the western tribes of Indians for a number of years, informs me that some of the Ute Indians manufacture pottery at the present time, and as branches of the tribe extend into the district which abounds in these ancient mural remains, it is not singular that the process they still employ should resemble that of the modern Pueblo tribes of Arizona and New Mexico, of whom the former have probably learned the art. He says that for making their pottery "they use marl, which they grind between two rocks to a very fine powder. They then mix this with water and knead it as we would dough. Afterwards they roll it out into a rope-like shape about one inch in diameter and several yards in length. They then commence at the bottom of the jar, or whatever vessel they may be making, and coil the clay rope layer on layer, until they have the bottom and about three inches of the sides laid up. The tools for smoothing and joining the layers together are a paddle, made out of wood and perfectly smooth, and an oval-shaped polished stone. Both of these tools are dipped in the water (salt water is preferred), the stone is held in the left hand and on the inside of the vessel, and the paddle applied vigorously until the surfaces are smooth."

It is a very erroneous supposition, entertained by many, that the external indentation of Class II. has been effected by molding the vessel around the interior of a wicker-work basket, which has afterwards been burned away in the process of baking, leaving the laminated impression of the woven twigs. At first, this explanation seems plausible, but on careful examination I could find

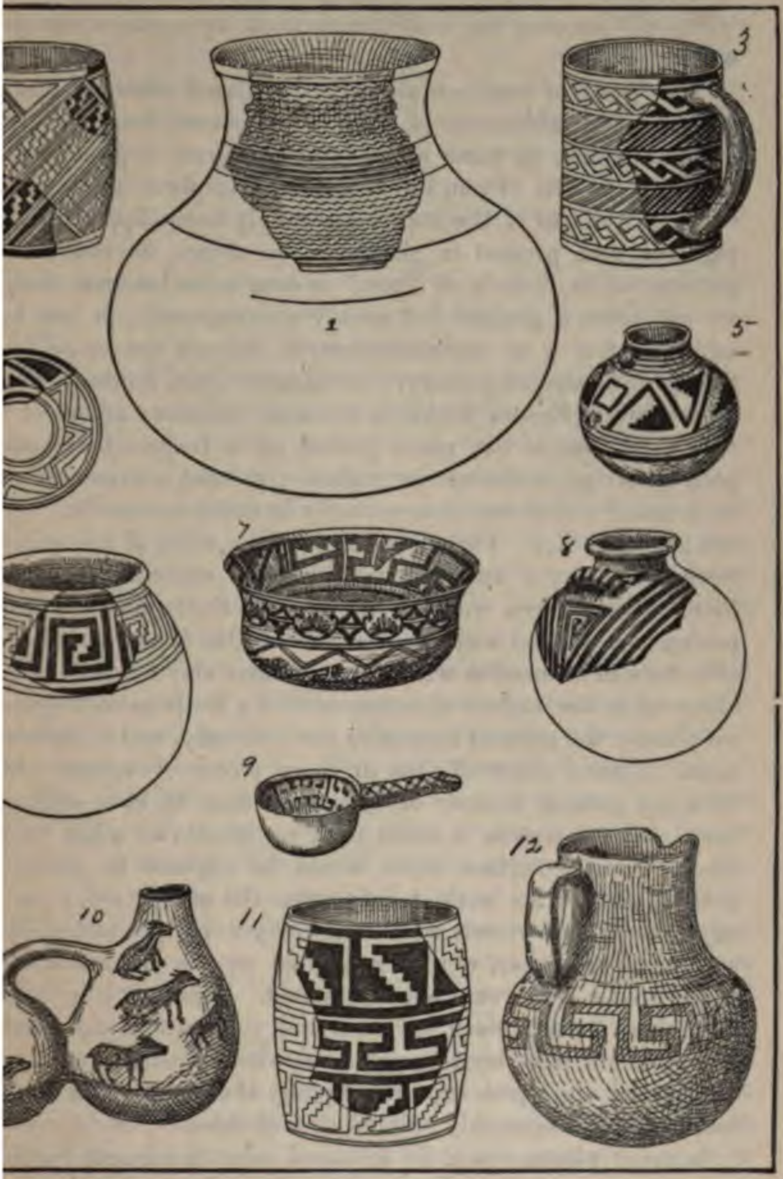

PLATE IX. ANCIENT POTTERY OF COLORADO, ETC.

not the slightest indication that this method had been followed; some of the vessels, however, may have been molded over gourds, which will account for their symmetrical appearance, especially on the interior.

The figures of ornamentation in the glazed ware are usually geometrical combinations of straight and curved lines, or fanciful designs, which, in some cases, exhibit a great degree of proficiency in the art. From the first rude attempts of the beginner, in which the end of the finger has simply been dipped into the pigment and pressed in places on the object, to the finished patterns of the "walls of Troy," or even more intricate designs, we can trace a gradual but steady advancement. It has been said that few or no representations of animals are to be found through this ancient pottery. In Eastern Utah, however, near a stream called Epsom Creek, a northern tributary arroyo of the San Juan, one of our party picked up a fragment of ancient pottery having on its convex surface a painted representation of an animal,[1] which was most probably intended for an elk. (Figure 21, Plate X.) This is reduced to one third of the original. Such specimens of ancient production are exceedingly rare, although the *modern* ware of the Moquis, Zuñis, and Pueblos is profusely decorated with such pictures. One of the most noticeable facts in connection with these ancient clay utensils is to be observed in the manner of ornamentation; for in some fragments we observe the painted figures on one side only, and in others on both. I have observed that in those pieces of vessels which, from the general contour or curve, are seen to have originally been such as possess a small neck or mouth, as a jug or jar, whose exterior surface alone would be exposed to view, the painted designs are worked only upon the convex side; on the other hand, those vessels which originally were open and shallow, as a bowl or dipper, were ornamented on the concave surface, as the under side would not be exposed. Again, it is noticeable that those vessels, such as vases and pots, whose sides, when entire, would have been upright, but whose mouths would have been broad and open, exposing equally the interior and exterior surfaces, were invariably painted *on both* sides.

In many pieces which lie scattered over the desert (perhaps ten per cent. of all the pottery found) there have been drilled small circular holes, which have evidently been made for the purpose of tying two or more broken fragments together when the vessel has been put to further use. Those perforations showing a funnel-like shape (as in Plate VII., Figure 2), with concentric rings, have been formed by the stone "rimmer" or sharp "borer." And we can see that in the majority of such cases the small circular orifice has been sunk *from the outside* or convex surface, as the opening there is larger than where it terminates on the interior.

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[1] Plate VII. Figure 1, was probably intended for a wild goat. The original painting was, possibly, as I have supplied the missing parts in the dotted lines. It was produced by a clumsy hand, yet I am satisfied that it was designed to represent an animal of some sort, forming a very good example of aboriginal caricature.

The earthenware utensils, according to their original forms and uses, may be classed under three heads: I. Sepulchral urns. II. Water vessels. III. Food receptacles.

The first division comprises vessels or *ollas* without handles, for cremation, usually being from ten to fifteen inches in height, with broad open mouths, and made of coarse clay with a laminated exterior (partially or entirely ornamented). Frequently the indentations extend simply around the neck or rim, the lower portions being plain. The second class includes jars, vases, jugs, pots, dippers, ladles, cups, mugs, saucers, and many other forms closely resembling our modern china. The third group consists of bowls, basins, and variously shaped dishes.

Sir John Lubbock, quoting Mr. Bateman's description,[1] says of European pottery, "'The urns generally accompany interments by cremation, and have either contained, or been inverted over, burnt human bones. They are generally of large size;'" Sir John Lubbock continues, they are "from ten to sixteen inches high, with a deep border, more or less decorated by impressions of twisted thongs and incised patterns in which the chevron or herring-bone constantly recurs in various combinations, occasionally relieved by circular punctures, or assuming a reticulated appearance. They are all made by hand, no trace of the potter's wheel being ever found on them. They almost invariably have an overhanging rim. The material of which they are formed is clay mixed with pebbles, and some of them have been described as 'sun-dried.' This, however, appears to be altogether a mistake, arising from the imperfect manner in which they are burnt. In color they are generally brown or burnt umber outside and black inside."

This description of the pottery (burial urns) of Europe will apply in every respect, with the one exception of ornamentation, to that of the West.

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[1] Prehistoric Times, page 165.

In many fragments of the mouths of jars a horizontal projection around the inner circumference of the lip is noticeable. (Plate VII., Figure 3). This, no doubt, was intended for the resting-place of a lid, and indeed we find many of these scattered through the *débris* of the ruins. The most ordinary form of lid is a simple flat circle (Plate VII., Figure 4) which fits closely into the mouth of the vessel. Plate IX., Figure 4, shows another discoidal lid. Mr. Holmes found, in an old ruin in the Mancos Cañon, two vessels with their lids fitted into them. He remarks, "Roughly-hewn *stone* lids were fitted carefully over the tops, but both were empty. One had been slightly broken about the rim, while the other had been pierced on the under side by some sharp instrument, and had been mended by laying a small fragment of pottery over the aperture on the inside and cementing it down with clay. They are of the ordinary corrugated pottery, and have a capacity of about three gallons." An improvement on this is the lid with a central button (Plate VII., Figure 5), by which it can be lifted more readily. Advancing in the scale of improvement we find the ornamental knob which is suggestive of our modern sugar-bowl top. Plate VII., Figures 6 and 7, will show two other varieties of ancient lids.

Nearly every article of household ware was adorned with one or more handles, and these, being so very numerous, present the greatest possible diversity in shape, design, size, and finish. There is the straight, long handle of the dipper, either plain or fanciful; there is the semicircular handle of the mug or cup, and the circular loops of the water-jug. All these general forms are so varied that it is seldom that two are found of like patterns. It is very evident that this ancient race was particularly partial to handles, and every vessel upon which a handle could be placed was supplied with one or more. These usually had been hollowed out when the clay was still damp, by thrusting sticks or straws through their centres, as may be proved by the impressions left in the clay. This was done, no doubt, for the purpose of making the vessel as light in weight as possible. Occasionally, however, we discover a handle which is solid, especially when it is slender or curved. The extremities of some of these were, as previously mentioned, occasionally molded into representations of the heads and ears of animals or beaks of birds. (Plate VIII., Figure 2, representing an owl; see also Plate XI., Figure 10.) Often the glazed appendages were painted in various designs. A very curious and ingenious contrivance was picked up among

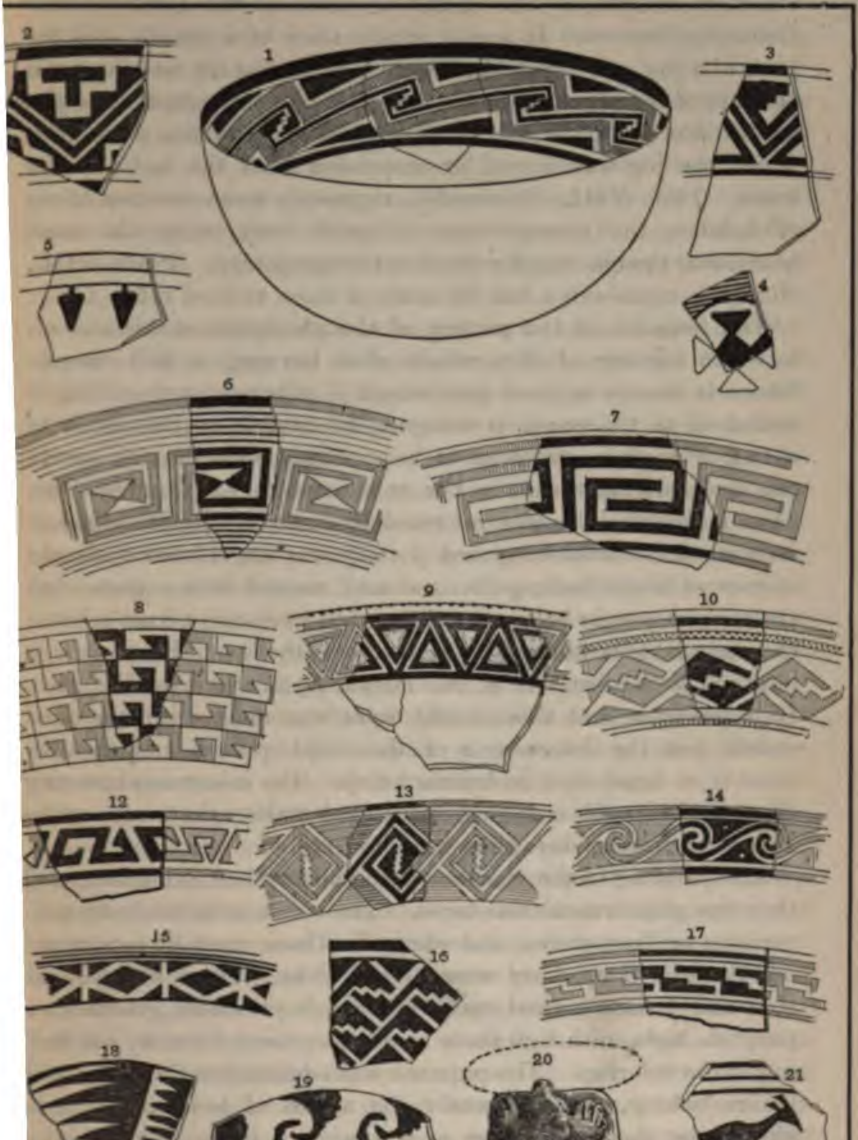

PLATE X. ANCIENT POTTERY OF COLORADO, ETC.

the ruins of Utah, by one of the members of the United States Geological Survey. It was a combination of a handle and the neck of a jug. (Plate VII., Figure 8.) Across the middle of the opening of the vessel extended a hollow clay tube, separating the mouth into two divisions. Through this a thong was passed, by which the jug was carried or suspended from the walls of the house. Plate VIII., Figures 3–8, represents some common forms of handles, the straight ones (Figures 6–8) being the most numerous, though usually the most fragmentary. Plate VIII., Figure 5, represents a handle made of three twisted rolls.

The material of the pottery of the aborigines consists of an infusible mixture of clay, which, after burning, is still opaque. There is always a great percentage of silicious earth, which is increased as the vessel is designed to be firm or less liable to shrink or crack on exposure to heat. Pulverized flint or quartz was probably much used in the ancient pottery. Captain John Moss states that he was informed by some of the Moquinos of Arizona that the older glazed pottery was made from a certain species of white rock, pulverized and worked into a paste, but the modern people have never been able to discover from whence the material was obtained. If such was the case, the process is now one of the lost arts of the Moqui, Zuñi, and Pueblo tribes. It is probable that this ancient ware was made from pounded quartz, but the descendants of these old potters employ only what is at hand, that is, ordinary clay. The calcareous covering of mollusks could not have been used unless they were more abundant in those days than they now are.

The painting of the ware was accomplished before burning, and then the glaze was administered. The colors were made by pulverizing brilliant stones and earths.[1] Those used in ornamenting the glazed crockery were black, white, yellow, brown, and red; and I have picked up pieces which presented greenish or purplish tints, although these may be accounted for by the fading of the coloring. The pigment was administered to the vessel before baking, and frequently the action of heat might have altered the chemical nature of the original hues. The glazing was not calcareous, as it does not effervesce under acid, or, if at all, only slightly and in particular places, so that in all probability salt was used for glaze, as this mineral occurs abundantly throughout the country, both in a solid form and in solution in the waters of many of the springs, frequently combined with a little lime. Adair, in his History of the American Indians, describes a method of glazing employed by some of the southern tribes of our country. They place the vessels over a smoky fire of pitch-pine, which gives them a smooth, black appearance, as of enamel.

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[1] Mr. Foster, in his Prehistoric Races of the United States, says, "Professor Cox was informed that the New Mexican Indians colored their pottery black by using the gum of the mezquite, which has much the appearance and properties of gum arabic, and then baking it. Much of the ancient pottery from the Colorado Chiquito is colored, the prevailing tints being white, black, and red." Gregg, in his Commerce of the Prairies, says that this pottery was also colored with the juice of a plant called guaco.

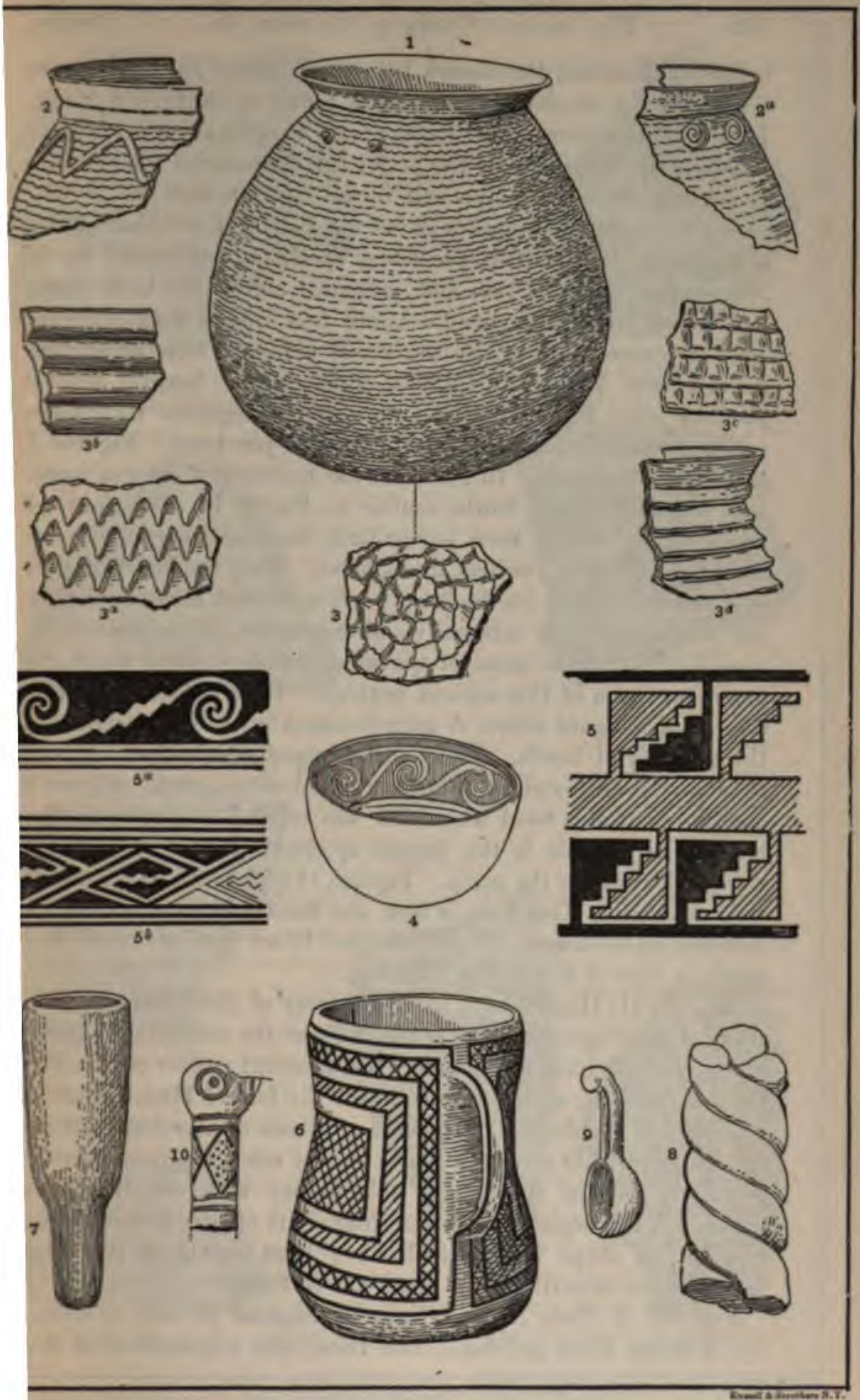
Some of the ancient pottery may have been shaped by the operation of casting, for no indications of the potter's wheel or lathe can be discovered. Beyond doubt a portion of the ware was formed by molding, and in some instances the lower halves of small-mouthed vessels were shaped in a matrice or between two molds, while the upper portions, including the neck and handles, were finished more rudely by hand. This peculiarity may be seen in many broken fragments where the interior of jugs is exposed to view. In several dippers which I have before me I can readily perceive that the handles were modeled over cylindrical sticks, somewhat greater in diameter than an ordinary lead pencil, and, previous to completing the end, the stick was withdrawn, leaving fine parallel lines and ridges around the interior of the hollow tube. Then a piece of clay was added to the extremity, and rounded and smoothed into shape.

In fact, though these prehistoric people were considerably advanced in some of the useful arts, and were cognizant of the general principles by which they were employed, they were sadly ignorant of the use of tools, even of the most simple patterns; and yet, to-day, tons of this hand-made pottery may be gathered through the cañons of the far Southwest. This class of fictile fabrics resembles more closely the modern ware of civilized peoples than that of any other aboriginal or ancient tribe, in the forms of the vessels, the symmetrical finish, the coloring, glazing, the manner in which it has been baked or burnt, and the quality of the ware. It exhibits a greater advancement in the ceramic art, and shows that those people who manufactured it were well along in civilization. It is entirely different from any of the pottery of other ancient tribes, especially of those Indian tribes east of the Rocky Mountains; and in the quantity which was made, it stands *alone* in the annals of prehistoric man.

Plate IX., Figure 5, represents a very perfect specimen of ancient ware found in the Pueblo de Chelly; it is about three and a half inches in diameter, symmetrically shaped, and accurately painted. It is, indeed, one of the most perfect and best finished specimens which has ever been brought from the West.

Plate VIII., Figure 9, represents a fragment of a jar of the indented ware; Plate VIII., Figure 10, a portion of an ancient dipper, and Figure 11 a rare piece of pottery, ornamented in white on a smooth, black ground. This ornamentation has been accomplished, doubtless, in part or wholly, by stretching twisted thongs and straws across the surface and painting over the whole. This leaves the lines of white spots and the stripes. The original vessel was a large one (probably a foot and a half in diameter), and much labor must have been expended in its ornamentation.

Occasionally the ancient potters applied the decorative art to the entire external surfaces of vessels. Figure 12, Plate VIII., shows a portion of the bottom of an urn of the indented variety, in which the design consists of impressed lines alternating in series of circles and rows of scales. In this specimen the ornamentation has been accomplished, the circles by the pressure of a sharp or pointed instrument, and the rest by means of the side of a rounded stick at regular intervals, and finished by the thumb of the maker. This bottom is generally convex but somewhat flattened at the centre, so that the original jar would stand on a level surface without support. In another specimen of a water vessel I observed eight small notches or cuts close together on the edge of the rim, which had evidently been filed there with a sharp or serrated instrument of stone. These I believe to have formed a tally or score, perhaps registering the number of times the vessel was filled at the spring on some particular occasion. Figure 1 of Plate IX. represents a fragment of a jar, and the reconstructed vessel found in the valley of Epsom Creek, Utah. It is of the indented ware, and was made by winding narrow strips of clay spirally, one edge of each whorl overlapping an edge of the next. The scaled appearance was produced as usual by indentations of the thumb, and for variety several rows were often left untouched. The dimensions of the original were about eighteen inches in diameter and height, and half this distance across the mouth. Figures 2, 3, and 11 show the original forms of restored mugs or cups. Figure 3 is a particularly fine example of this style of vessel, having a double handle. These average four inches in height. Figure 6 is a fragment of an urn possessing a recurved lip. The entire vessel was probably ten



Russell & Struthers N.Y.

PLATE XI. ANCIENT POTTERY OF COLORADO, ETC.

inches in diameter, the mouth being five inches across. Figure 8 represents a diminutive jug which I dug up at Aztec Springs. In it I found a number of fragments of burnt corn-cobs. It had two opposite handles near the neck; the diameter of the globular vessel was about four and a half inches, and an inch and a half across the mouth. Figure 9 shows a common utensil shaped like a dipper or ladle. This particular specimen was picked up in Montezuma Cañon, Utah, and measures across the bowl three and a half inches, the handle being four inches long. Figure 12 is an exceedingly interesting vessel exhumed from an ancient grave of the Mancos by Captain John Moss. Several similar pitchers were taken from the same tomb, together with some polished stone implements and a human jaw-bone. Figures 7 and 10 are modern. In Plate X. the majority of figures represent fragments from bowls, similar to Figure 1. This form of vessel seems to have been particularly abundant, varying in size from two inches to two feet in diameter. They are highly glazed and painted usually on the inner surface, though sometimes they are ornamented both internally and externally. This plate is intended to illustrate some of the more artistic designs which are found on much of this ancient pottery. Figure 4 shows a Maltese cross, a figure which is quite common in the inner centre of the bottoms of bowls. Many such designs were picked up, and they have been found in ruins a hundred miles apart. Figure 9 is a fragment of a bowl whose rim was originally thirteen inches in diameter. This is the largest specimen of the finer glazed ware discovered by the party. Figures 13 and 14 are particularly well executed. This ware is firm and hard, and never exceeds a half-inch in thickness. Figures 18 and 19 are portions of smaller bowls or cups of five inches diameter.

Mr. W. H. Holmes says of the pottery of the Mancos, "The study of the fragmentary ware found about the ruins is very interesting, and its immense quantity is a constant matter of wonder. On one occasion, while encamped near the foot of Mancos Cañon, I undertook to collect all fragments of vessels of manifestly different designs within a certain space, and by selecting pieces having peculiarly marked rims I was able to say with certainty that within ten feet square there were fragments of fifty-five different vessels. In shape these vessels have been so varied that few forms known to civilized art could not be found."

Figure 1 of Plate XI. is a large corrugated jar with a capacity of about three gallons. The vessel was commenced at the

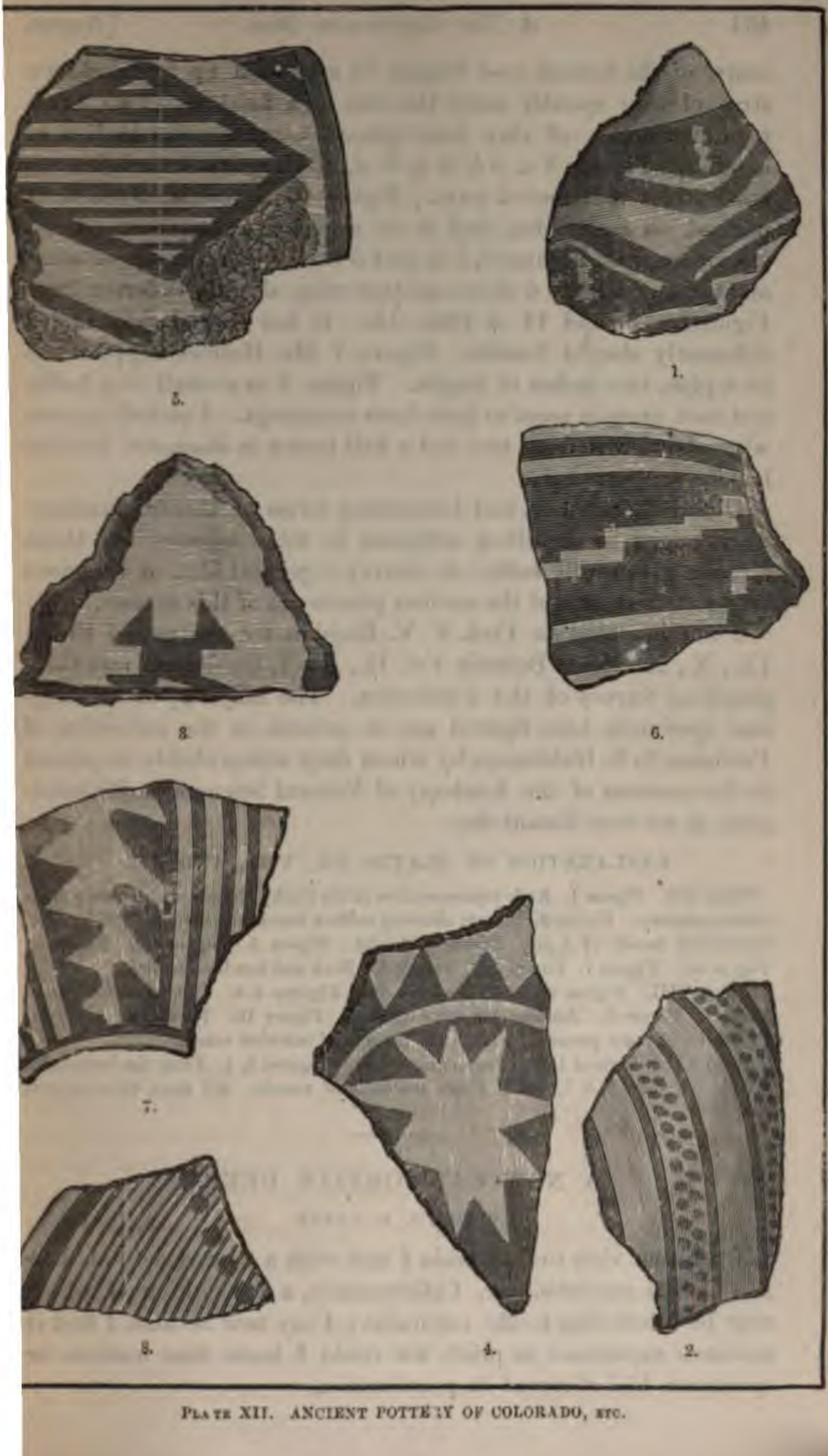


PLATE XII. ANCIENT POTTERY OF COLORADO, ETC.

centre of the bottom (see Figure 3) and built up by winding a strip of clay spirally until the rim was finished. Two ornamental rosettes of clay were placed near the rim in lieu of handles. Figures 3 *a*, 3 *b*, 3 *c*, 3 *d*, and Figures 2 and 2 *a* are other styles of indented ware. Figure 4 is a reconstructed bowl painted on both sides, and is an excellent example of careful workmanship. Figures 5, 5 *a*, and 5 *b* are other samples of ornamentation. Figure 6 shows another mug, slightly different from Figures 2, 3, and 11 of Plate IX. It has curved sides and a differently shaped handle. Figure 7 Mr. Holmes supposed to be a pipe, two inches in length. Figure 9 is a small clay ladle, and such utensils seem to have been numerous. I picked up one whose bowl was about two and a half inches in diameter, but the handle was wanting.

Different, peculiar, and interesting forms of this fragmentary ware might be described sufficient to fill a volume, but those already given will suffice to convey a general idea of the more important features of the ancient plastic art of this section.

I am indebted to Prof. F. V. Hayden for the use of Plates IX., X., XI., from Bulletin Vol. II., No. 1, Geological and Geographical Survey of the Territories. The majority of the original specimens here figured are at present in the collection of Professor S. S. Haldeman, by whom they will probably be placed in the museum of the Academy of Natural Sciences of Philadelphia, at no very distant day.

EXPLANATION OF PLATES VII., VIII., AND XII.

Plate VII. Figure 1. Rude representation of the Rocky Mountain sheep or goat on ancient pottery. Figure 2. Pottery showing orifices bored with a rimmer. Figure 3. Horizontal mouth of a jar. Figure 4. Jar-lid. Figure 5. Top of lid. Figure 6. Top of lid. Figure 7. Top of lid. Figure 8. Neck and handle combined.

Plate VIII. Figure 2. Owl's-head handle. Figures 3–8. Curved and straight handles. Figure 9. Ancient jar reconstructed. Figure 10. Portion of a dipper. Figure 11. A rare pattern. Figure 12. Bottom of indented vessel.

Plate XII. Figures 1, 2. Fragmentary ware. Figures 3, 4. From the bottoms of vessels. Figures 5, 6, 7, and 8. From the rims of vessels. All three fifths natural size.

A NEW CALIFORNIAN DEER.

BY HON. J. D. CATON.

IN a recent visit to California I met with a new variety of deer (*Cervus macrotis*, var. *Californicus*), a description of which may be interesting to the naturalist; I say new because I find it nowhere mentioned in print, nor could I learn that hunters or sportsmen had observed its peculiarities.

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PLATE VI.

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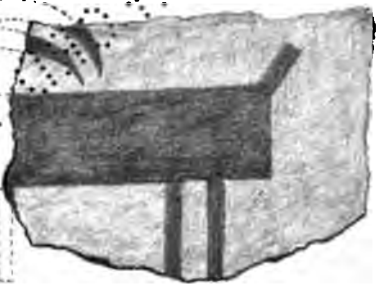

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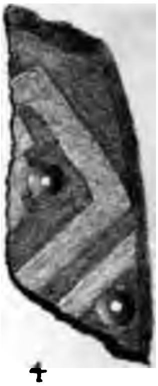

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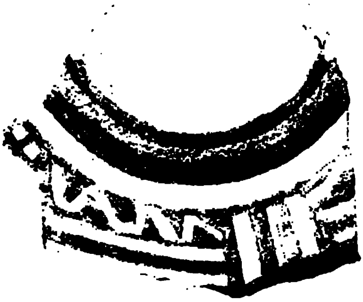

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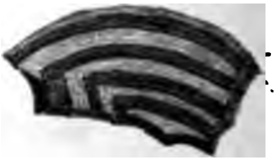

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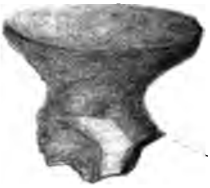

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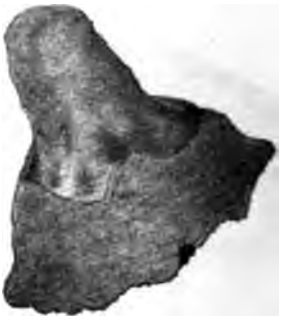

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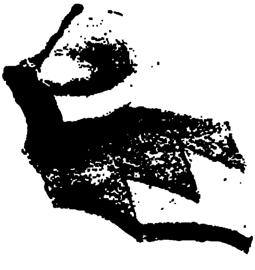

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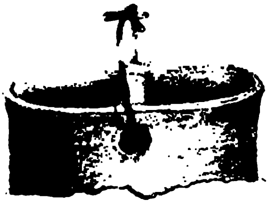

J. S. Kingsley, on Stone

Ancient Pottery of Colorado etc.

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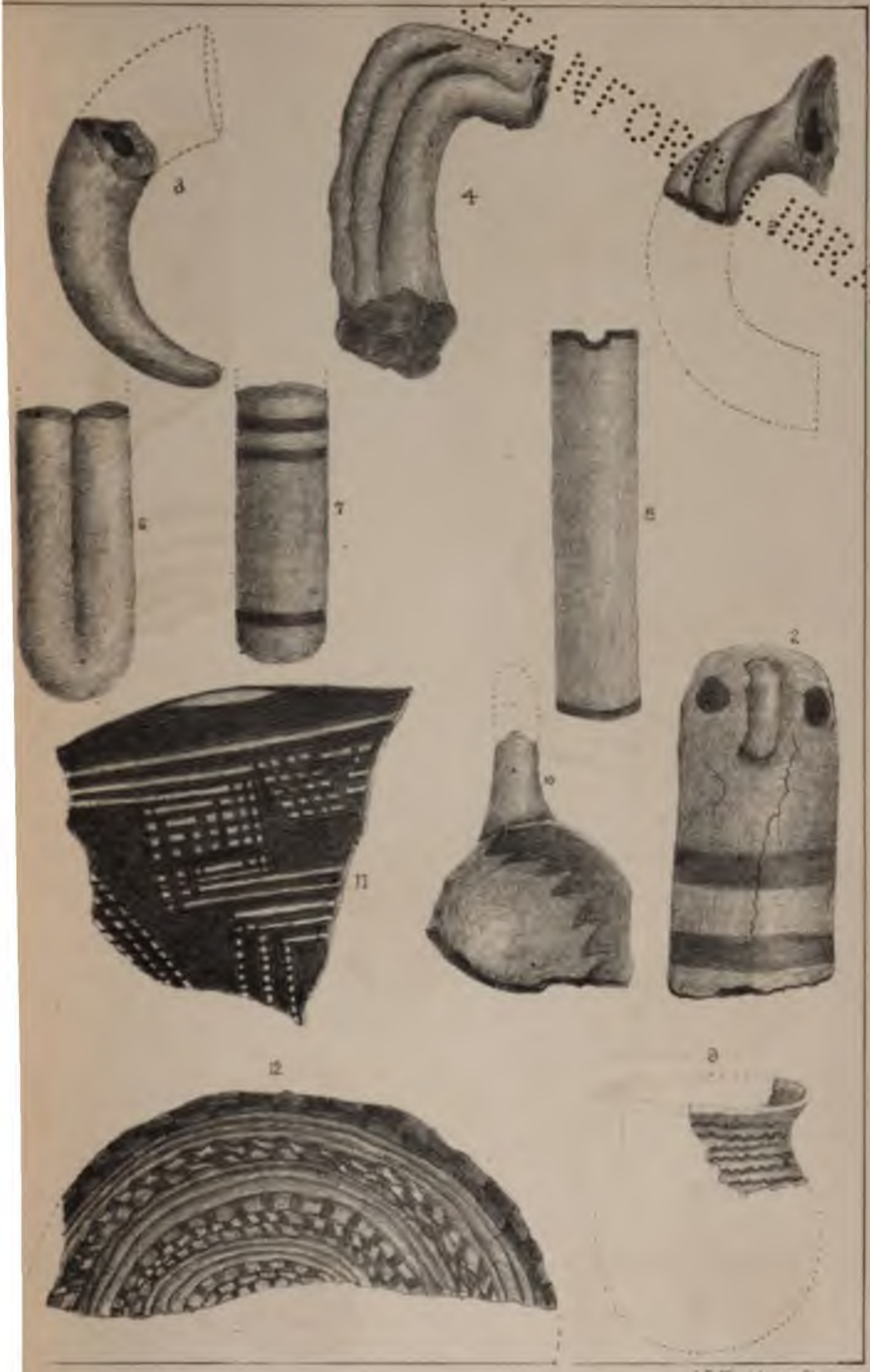

J. S. Kingsley, on Stone

Ancient Pottery of Colorado, etc.

Before my arrival at Santa Barbara the fame of Mr. Frost, the leading merchant of the place, as a deer-hunter, had reached me, and soon after my arrival I made his acquaintance and inquired concerning the deer of the vicinity. He showed me many interesting specimens of antlers, a few dried skins, and a last year's fawn in domestication, but unfortunately the tail of the latter had been bitten off by a mule.

I saw at once that we had something I had never met before or seen described. I expressed a strong desire for an opportunity to study it further, when Mr. Frost invited me to join him in an excursion to the mountains to procure a specimen, which of course I gladly accepted. At six o'clock on Tuesday morning, the 21st of March, he drove up to my hotel, accompanied by Mr. Miller, another merchant of Santa Barbara, no less fond of the chase, the wagon stored with every convenience for camp life. We followed up the coast forty miles to Gaviota, where we crossed the Coast Range through the Gaviota Pass, the summit of which I found to be one thousand and fifty feet above the sea, and made camp in a secluded valley, among abrupt hills varying in height from one hundred to four hundred feet. Some of these were covered with wild oats to their very summits, while others were clothed with open, park-like live-oaks, or dense chaparral. The afternoon was spent in making camp, observing the character of the country, and listening to the love notes of the great flocks of quail (*Lophortyx Californicus*), whose breeding season was about to commence.

Next morning by daylight coffee was drank, and the hunters were off to the hills. As the excursion was strictly for scientific purposes, it was understood that only bucks were to be shot at. By noon three specimens were brought into camp, which were all I desired, and afforded me every opportunity for a critical study.

I found them to be a very pronounced variety of *Cervus macrotis*. Of the species there could be no mistake. There was the large ear, the very large metatarsal gland, more than four times as large as on the black-tailed deer (*Cervus Columbianus*), and more than ten times as large as on the common deer (*Cervus Virginianus*), but above all the under side of the tail was naked to about the same extent as on the tail of the horse. Now this is a peculiarity not found on any other of the American deer, and I do not know that it is observed on any foreign species; and as it is as constant on this deer as on the horse, it becomes an important specific character, and, had other important similitudes been wanting, would have gone far to identify the species. I will not stop to point out other features peculiar to *C. macrotis*, but will rather describe the differences between this variety and that found east of the Sierra Nevadas.

Those found in the low altitudes where we made our camp are hardly as large as those found on the high table-lands east of the Sierras and in the Rocky Mountains, but I learned that those found in the higher mountains, say five thousand feet or upwards above the sea, are very large. Mr. Frost once killed one in the high mountains which was believed to weigh four hundred pounds. This deer frequents higher altitudes than any other deer, being frequently found above the timber line. I have not the means of comparing those found at San Julian (that was the name of the ranch on which we made our camp) with any living on so low an altitude elsewhere. In color these deer had a decidedly more reddish shade than those east of the Sierras, much more approaching the color of *C. Columbianus*. Those, however, found in high altitudes were described as of the dull gray color of the eastern variety. On the mule deer (*Cervus macrotis*), there is a snow-white section which commences just above the root of the tail and extends down the buttock for several inches on each side to nearly the length of that member. This white section on the specimens of the California variety which I examined was not quite so extensive as on the eastern variety, though in all other respects they were identical. But the most marked distinction of this new variety was in the markings of the tail. On all the specimens I have examined or heard of east of the Sierras, the tail of *C. macrotis* is entirely white except a tuft of long hairs at the extremity, which is black. On all that I examined west of the Sierras a dark line extends down the upper side of the tail, and unites with the black tuft at the end. This line varied in depth of color on different specimens, but was always very distinctly present, never of a lighter color than on the back above, but frequently considerably darker as it approached the black tuft, always showing many tawny hairs, which in several specimens invaded the tuft at the extremity; this on the eastern variety is always entirely black, except in summer, when it sometimes fades to a reddish shade. It was this dark line down the upper side of the tail which first attracted my attention on the dried skins examined, and excited the suspicion that this might be a new species of deer, which, however, was at once dispelled when I had opportunity for more careful examination. This mark, I learned from Mr. Frost and many others, is as constant on the large specimens found in the higher altitudes as on the smaller ones found at less elevations near the coast. It is uniform and constant, so far as I could learn, on all found west of the Sierras.

At first I suspected a relative of *C. Columbianus* rather than of *C. macrotis*, but when I observed that the dark line on top of the tail did not embrace more than one third of its circumference, while on the black-tailed deer all is colored except one quarter or one third on the under side, which is white, — in fact, that this is a white tail with a colored line on top, and the other is a black tail with a white line along the under side, — but above all, when I found the under side of the tail naked, while the tail of *C. Columbianus* is covered with a dense coat of hairs on the under side to the base, I saw at once it was no relative of the true black-tailed deer.

This was confirmed by observations made a few weeks later, when enjoying the hospitality of Mr. A. E. Kent, near San Rafael, north of San Francisco. Mr. Kent has a deer park inclosed in an admirable locality, and has in it four does and a buck, and felt sadly disappointed that the does had never bred. The first glance disclosed the cause of this sterility. The does were all of the true black-tailed deer, while the buck was of this new variety of the mule deer. When I pointed out the difference, he readily recognized it. The larger ears, the longer and coarser legs, the larger gland on the hind legs, and the difference in the form and color of the tail, were all very plain when pointed out, though he had not noticed them before, albeit there are but few if any more persistent deer-hunters in California, and none who have more carefully studied the habits of the deer in everything essential to the successful chase. Had the colored stripe on the upper side of the tail been wanting, as on the eastern variety, he would no doubt have observed the difference at once. The does were natives of the country north of him; the buck was presented to him by a friend, but he did not know whence he was procured; I expressed the opinion that he would on inquiry find that he came from the south, which he has since informed me was the case. I examined thirty or forty dried skins, the fruits of the chase by Mr. Kent, all procured north of San Francisco, along the Coast Range, within the distance of one hundred and fifty miles. Not one from a mule deer was found. All were from the black-tailed deer.

I lack the necessary information to enable me to determine the extent of the habitat of this variety of the mule deer. I think it safe to say that it predominates in the Coast Range south of Montera, and probably south of San Francisco, while it is rarely if ever met with in the Coast Range in California north of San Francisco. Good observers report *C. macrotis* in the Coast Range in Oregon, though of rather a small size, and I have most satisfactory evidence that it occurs abundantly in the Sierras in Northern California; but whether these are of the variety I have described I have no means of determining. I hope this article will induce naturalists and observers on the west coast to examine with critical care specimens from the various localities and let us have the result of their observations, so that this question may be determined. I expect that we shall find that the Sierras are the dividing line between the two varieties of *C. macrotis.*

I am informed by Professor Baird that the Smithsonian Institution some years since received several skins from Cape St. Lucas, of a very small variety of *C. macrotis* inhabiting the peninsula of California, with spike antlers, which were said to be fully adult, and not yearlings with dag antlers. Those skins were unfortunately destroyed, so that I could not examine them. I have thus far failed in my efforts to procure specimens from that locality. Mr. Burton, of Santa Barbara, who forty years ago hunted the sea otter along that coast, informed me that he found a very small variety of deer quite abundant on the island of Santa Margarita, off the coast of Southern California; but he could not describe it except that it was of diminutive size and quite abundant.

As soon as the deer reached camp I selected a fair specimen, a buck, which I judged to be four years old, and prepared the skin and necessary parts of the skeleton for mounting. This I subsequently sent to the Smithsonian Institution. Professor Baird has expressed much interest about it, and assured me that it would be mounted and added to the collection of American quadrupeds at the Centennial, where those who take an interest in these studies may examine and compare it with others.

After our work was done we enjoyed a most leisurely feast of venison prepared in all the different modes most approved in camp, sweetened by long absence and hard toil. After a late breakfast the next morning, in which venison was again most prominent, we leisurely broke camp and I bade farewell to one of the sweetest nooks for such a purpose I have ever seen. The rank wild oats which formed our beds, the bowers of flowering shrubs which loaded the air with a rich perfume, the music of the mountain brook which went dancing down near by on its way to the great Pacific, soothed to sleep at night and bade a pleasant welcome in the morning.

A NEGLECTED NATURALIST.

BY HERBERT E. COPELAND, M. S.

TO many of the untiring naturalists who fifty years ago accepted the perils and privations of the far West, to collect and describe its animals and plants, we have given the only reward they sought — a grateful remembrance of their work. Audubon died full of riches and honor, with the knowledge that his memory would be cherished so long as birds should sing. Wilson is "the Father of American Ornithology," and his mistakes and faults are forgotten in our admiration of his great achievements. Le Sueur is remembered as "the first to explore the ichthyology of the Great American Lakes." Laboring with them, and greatest of them all in respect to the extent and range of his accomplishments, was one whose name has nearly been forgotten, and is oftenest mentioned, in the field of his best labors, with pity or contempt.

The early field-naturalists had very imperfect conceptions of the relationship existing between closely allied forms, — for the necessary comparison can be made only after the accumulation of more specimens than are ever collected by one man, — and they therefore described as "species" forms due to geographical influences or individual peculiarities. Who among them erred most in this direction cannot yet be determined, for our own knowledge is too imperfect, a fact readily appreciated by those who have followed scientific thought at all closely for the last few years. We may, therefore, now pass judgment only on the honesty and truthfulness of these investigators, and for this we have two sources of evidence: first, the testimony of contemporaries; second, the testimony of their work. On the first head we have in regard to the subject of this sketch, the most emphatic statements from his friends and co-laborers, Swainson and Audubon. If there be anything recorded against the integrity of his intentions, diligent research has failed to reveal it to me. It is my present purpose to present an outline of his work, for the consideration of the candid reader.

C. S. Rafinesque was one of the geniuses that occasionally appear, to puzzle people of steady habits. His early life was full of the vicissitudes which may be told of nearly every pioneer in American science, and he was thrown on our shores for the second time from a shipwreck in which he had lost every tangible result of his labors in science; the sea had taken everything but hope and energy. Similar misfortunes have since broken the spirit of more than one student of science, but whatever cloud these may have cast over the mind of Rafinesque, it did not affect his zeal and capacity for work, and the result was so prodigious that I confine myself to a consideration of his labors in ichthyology, since here he has received most blame from recent followers, and pass by his work in the other branches of science with only a statement of the result.

He proposed a natural system of classification in botany at a time when the Linnæan system was as universally recognized in this country as is the binomial nomenclature now. Thirteen genera, eight subgenera, and sixteen species of the plants referred to in Gray's Manual are his. His writings on conchology have been considered worth editing by Binney and Tryon. Of our reptiles and batrachians, four genera and six species bear his name. He described four genera and four species that are retained in the current literature treating of our mammals. The genus *Helmitherus* of birds was proposed by him. There is implied in this brief outline an amount of labor to be appreciated only by those who themselves are laborers.

In 1820, the year in which Maine was admitted to the Union, when the population of the United States was about nine million, and the population of Cincinnati was nine thousand, there was published at Lexington, Ky., "for the author," C. S. Rafinesque, a little octavo book of ninety pages, with the following title: "Ichthyologia Ohiensis, or Natural History of the Fishes inhabiting the River Ohio and its Tributary Streams. Preceded by a Physical Description of the Ohio and its Branches," and with the following motto: —

"The art of seeing well, or of noticing and distinguishing with accuracy the objects which we perceive, is a high faculty of the mind, unfolded in few individuals, and despised by those who can neither acquire it nor appreciate its results."

The book is now very rare, the borrowed copy before me, although worn and faded, being valued at fifty dollars, so that it is very difficult to verify a reference to it or to consult the original descriptions. This may have led European writers, intrenched in the conviction that no traveling naturalist could invalidate or even anticipate the labors of a Cuvier or a Valenciennes, and even frankly stating that "the natural history of North American fresh-water fishes is in its infancy, and only a small proportion of the literature pertaining to it has been critically examined," to believe that they could afford to reject all of Rafinesque's work, and then coin such contemptuous expressions as "Rafinesquian genera" for groups rejected without examination. I may say here, however, that the term is not a reproach to those acquainted with the value of the work, for Rafinesque was the first writer on American fishes who distinguished with even tolerable accuracy those groups now called genera, and for thirty-five years after him there was no writer on our fishes of whom Professor Agassiz's words are not true, that "most of their generic descriptions are only vague specific descriptions, and their specific descriptions refer chiefly to individual peculiarities of the specimens before them."

American writers who have neglected Rafinesque may plead the same difficulties in extenuation, but have in some cases, I am willing to believe, been influenced more by the habit of neglect toward him. As a fisher in the streams tributary to the Ohio I have become profoundly impressed by the accuracy of the work he did when laboring under so many disadvantages. He was surely indefatigable in collecting, and more accurate than the custom and habit of his time demanded. The general confusion characterizing so much of the literature on the fresh-water fishes of the United States may afford some reason why no one has made a distinction, in the case of Rafinesque, between the descriptions from specimens he had seen and those based on the report of others. The failure so to distinguish, added to the unfortunate results of the well-intended attempt at identification by one or two western ichthyologists, and the consequent lack of confidence when the discrepancies were proved, has led to the rejection of nearly all his work and to the addition of many useless synonyms to our nomenclature.

Rafinesque referred a few fishes conjecturally to genera on the testimony of others, when he had never seen a specimen. These may be dropped without remark or prejudice, in accordance with the universal custom.

He gave descriptions of some very singular fishes from drawings by John James Audubon. Whatever blame there may be belongs to the artist. It is scarcely necessary to say that Audubon's paintings of birds are wonderfully accurate, and that his skill and truthfulness as a field-naturalist were such that one of his descriptions is considered to be worth respect, even if contradicted by his best successors. Rafinesque had particular reason to trust him, for on his denying the existence of a flower Audubon had painted, he was led to discover a new genus. Such proof was not always possible, and why should he doubt the existence of a fish painted in its life colors by the same gifted hand? Valenciennes and Richardson have described species of fishes that yet hold a place in so celebrated systematic literature as the Catalogue of the Fishes of the British Museum, from Chinese drawings. We may be pardoned for retaining the descriptions of Rafinesque from the paintings of Audubon; we may surely drop them without reproach to the author.

His descriptions of the fishes he collected cannot, in many particular cases, be surpassed, and are generally recognizable even among the cyprinoids or minnows, where, on account of their close resemblance to each other, there has always been the most confusion. The first good word was spoken for him by Kirtland, but the value of his work was not fully recognized until 1856, when Professor Agassiz was receiving collections from the tributaries of the Ohio. In his Fishes of the Tennessee he restored many of Rafinesque's names, and defended his memory against the harsh treatment it had received from the few writers who had noticed his work, expressing much regret "that his contemporaries did not follow in his steps, or at least preserve the tradition of his doings, instead of decrying him and appealing to foreign authority against him." After that time, however, Professor Agassiz made but few contributions to American ichthyology, and the general neglect continued to such an extent that a writer in the employ of the government took the trouble to describe badly many of the fishes that Rafinesque had described well, and in our own day authors have made new genera with descriptions no better than Rafinesque's for the same fishes.

Occasionally, however, as the fishes of the Ohio are becoming better known, one of his descriptions has been recognized, and recently Prof. David S. Jordan has published a thorough review of Rafinesque's work, based on collections of a large number of specimens from the streams in which he fished, and has restored many of his names. The result at last fully justifies all I say of this gifted ichthyologist, for of seventy-nine genera and one hundred and fifteen species of fishes known as inhabiting the Ohio and its tributaries, twenty-nine genera and thirty-seven species were first described by him, and the eliminating of seasonal and sexual forms from the rank of species, and the identifying of more of his genera on a better acquaintance with the fishes of the Ohio, will constantly make the ratio greater.

I have not been actuated in the writing of this sketch wholly by a desire to see justice done. Professor Agassiz — and I quote him so often because he spoke so well before me in this matter — said, "Both in Europe and in America he has anticipated most of his contemporaries in the discovery of new genera and species in those departments of science he cultivated most perseveringly, and it is but justice to restore them to him whenever it can be done."

But if we hold our duty lightly in regard to our treatment of these old naturalists, we are driven by our necessities to attempt the establishment of the oldest names that were accompanied by a recognizable description, for the nomenclature of our animals has become a matter so fearfully intricate that it has retarded in no slight degree the advancement of science, by repelling those naturally fitted for the work.

THE OCCURRENCE OF WHITE EGRETS AT TRENTON, NEW JERSEY.

BY CHARLES C. ABBOTT, M. D.

ON Monday, August 2d, 1875, it commenced raining early in the morning and continued day after day, with the exception of one day, until Friday, the 20th. The wind varied only from southeast to south. About ten and one tenth inches of rain fell, and in consequence the meadows bordering on the Delaware River were overflowed to a depth varying from two to six feet.

On the 14th of August a flock of thirty snowy herons (*Garzetta candidissima*) made their appearance, keeping much together, avoiding the clumps of tall trees, and at times associating very familiarly with a flock of domestic geese. Occasionally the great blue herons (*Ardea herodias*) were seen in scanty numbers, either alone or associated with the white herons, and every day there were numbers of the small blue herons (*Florida cærulea*), but these excited no comment from those familiar with the locality, as they are quite abundant every year, as are also the night heron (*Nyctiardea gardeni*), the bittern (*Botaurus lentiginosus*), the green heron (*Butorides virescens*), and the least bittern (*Ardea exilis*).

August 17th a small flock of white egrets (*Herodias egretta*) made their appearance, and associated familiarly with the white herons that had preceded them by three days. A tract of level meadows, of some seventy acres in extent, seemed particularly attractive to these birds, and I had excellent opportunities for watching their habits during their brief stay.

It is proper here to state that thirty years ago both of these species of white herons were quite common along the Delaware River from May to September, but they have now almost entirely disappeared, especially during the past six years, during which time I have failed to note their presence, except single specimens flying over.

My studies of the habits of birds during the past and preceding summers have frequently suggested to me that when any bird or flock of birds *deliberately* chose to frequent a very limited locality for a comparatively long time, notwithstanding the danger of the presence of man, their habits would indicate exercise of faculties that could not be considered simply instinctive; that the exercise of unusual care, forethought, and deliberation would be noticeable in their endeavors to avoid real or supposed dangers from the proximity of man. To what extent this is true is, I think, partly shown in the notes I have taken down in the field from August 14th to September 9th inclusive. How these movements should be interpreted the reader must judge for himself, but I think the explanation here given nearest in accordance with the facts, which I regret being unable to describe as clearly as I wish. Valuable as they undoubtedly are, written descriptions give but a faint idea of the varied movements and daily habits of our birds, which to be really appreciated must be seen.

It is very evident that these white egrets know that their color renders them quite conspicuous. I noticed every day the same movements on their part, which demonstrated their appreciation of this fact. They carefully kept in the centre of the tract of meadow, except when feeding, and then never ventured nearer than one hundred yards to the wooded margins of the meadow or near outstanding trees. This shyness, as it would be called, was not of itself at all remarkable, but as it was accompanied with another habit having direct relation to it, it was very curious, and indicative of thought. This second habit was that of rising to a very great height always when passing over woods, as was necessary on coming in from the river, along the banks of which they appeared to roost. While the less timid blue herons would pass leisurely along the tree-tops, not a dozen yards above them, the white herons on being disturbed would rise rapidly to an unusual height, and, apparently keeping directly over the spot where they had been standing, would not commence an onward flight until the upward one was sufficiently prolonged to assure them that they were wholly out of harm's way. So when returning to the meadow they would, as it were, drop from the clouds, while the blue species would quietly wing their way along at a height of from ten to forty yards.

Now, inasmuch as no white egrets have, in any numbers, visited this locality for several years, and as in the Southern States they are little, if at all, more wary than the blue herons, it seems to me to follow necessarily that their peculiarity of flight, as instanced in avoiding supposed dangers, could not be hereditary, and was really an exercise of unusual care, forethought, on the part of these birds; a mental operation akin to thought in man, and having nothing whatever to do with instinct as understood by us.

Why, indeed, a flock of these egrets, for nearly four weeks, should frequent daily a tract of meadow so small as this of seventy acres, it would be very difficult if not impossible to determine; but such being the case, I naturally endeavored to mark their feeding habits carefully, and this, with the aid of a good field-glass, I was able to do. Their food consisted exclusively, while on the meadows, of frogs and grasshoppers, and especially of the latter, which were very abundant, and, having been caught by the freshet while in the long grass, were so wet and draggled that they could not escape by flight. The smaller herons seemed always occupied in gathering up the grasshoppers, and never stopped to plume themselves or take a quiet nap on one leg as the blue herons are so fond of doing. The egrets (*Herodias egretta*) on the contrary, seemed to weary of gathering grasshoppers and frogs, and would spend much time in dressing their feathers; but while really undisturbed they never ceased to be suspicious, and the little flocks seemed to have a mutual understanding for their common safety, as every fifteen or twenty minutes one of their number would rise well up into the air and circle slowly about as if to see if the coast was clear. If at such a time any person was noticed approaching, or I purposely showed myself too near them, the flying egret would give a loud, shrill call, and they would all rise up immediately and be gone for perhaps an hour. I frequently disturbed them, and so uniform was their action at such a time that I could exactly describe in advance to a friend what would be their movements when I alarmed them. So unvarying was their method of leaving and returning to the meadow that it seemed only explicable by considering it the predetermined routine, resulting from a consultation had among them when circumstances first led them to the spot in question.

As an instance, also, of these birds apparently "studying the situation," I daily noticed a change in their habits as the waters began to subside and restricted their range of submerged land. They seemed to know full well that an open meadow, six or eight inches under water, afforded no "cover" for their arch-enemy, man, but that he might crawl dangerously near in the long, tangled grass, now again exposed. The indication of this supposed train of thought on the part of the herons consisted in their increased suspicion, and the steadily increasing number of circular flights on the part of some of their number to see if any danger was near by.

It were useless to endeavor to give a detailed account of their many interesting movements, all of which were so indicative of genuine *thought;* but the whole series of observations, as I now recall them, and the perusal of my field-notes, more than ever fully convince me that these egrets, like all birds, depend upon, and are successful in life, I may say, more from their reasoning powers and their quality than they trust to or are dependent upon the operations of instinct.

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THE HOUSE FLY.

BY A. S. PACKARD, JR.

A BRIEF history of the common house fly, which abounds to such an annoying extent in August, may not be out of season, especially as until within two or three years we were quite in the dark as to its mode of life and transformations. The Mémoires of the Swedish count, DeGeer, published just one hundred years ago, contain the first notice of the house fly, while a fuller account is given in an obscure book by Bouché, a German entomologist, published in 1834. Two years ago the writer made a special study of the mode of growth and life-history of the fly,[1] the leading points of which are here reproduced.

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[1] On the Transformations of the Common House Fly. (Proceedings of the Boston Society of Natural History, xvi., 1874.) 8vo, pp. 14.

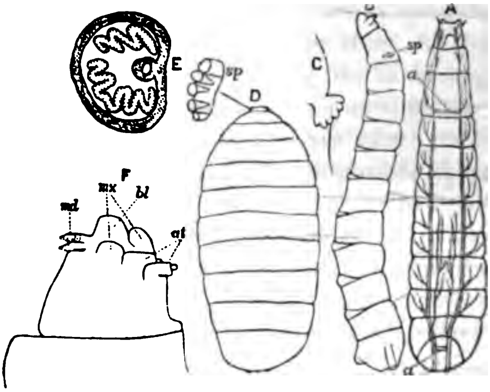
In the first place, is the common house fly of America the same as that of Europe? After a careful comparison of a number of individuals from Switzerland with many native examples, no difference could be found. How long it has been living in this country there are no data to show, and it may have been a passenger on the Mayflower, or buzzed in the cabin of Captain John Smith's vessel, or even performed its measured flight near the ceilings in the ancient town of Pemaquid.

During the month of August the house fly is particularly abundant, and especially so in the neighborhood of stables. On placing a fly in a glass bottle, she laid, between six P. M., August 12th, and eight the next morning, one hundred and twenty eggs. They were deposited irregularly in stacks, lying loose in two piles at the bottom of the bottle. At eight in the morning of August 14th several were found hatched out and crawling about the bottom of the bottle. But a greater number of young were desired for purposes of study, and an abundance of food in which to rear them. A mass of freshly-dropped horse manure, still warm, was placed at an open window in the sun. This, with fresh masses added from time to time, attracted numbers of flies for three or four weeks succeeding, which laid eggs during that period, so that thousands of young in different stages of development were obtained.

Immediately after exposing the manure on the morning of August 12th, the flies appeared, and, penetrating down, often out of sight, deposited bunches of eggs in convenient crevices. The egg of the house fly is long, slender, cylindrical, and a little smaller at the anterior end than at the other. It is .04–.05 of an inch long and about one quarter as thick. The shell is so dense that the early embryonic phases could not be watched, but enough was seen to enable us to determine that the mode of growth in the egg is nearly the same as that of the flesh fly, as observed by Dr. Weismann.

The eggs thus laid were found to hatch twenty-four hours later. In confinement they required from five to ten hours more, and the maggots hatched in confinement were smaller than those reared from eggs deposited in warm manure. Certain worms reared also in too dry manure were nearly one half smaller than those bred in more favorable circumstances. For several days the worms living in this dry manure did not grow sensibly. Too direct warmth, but more especially the want of sufficient moisture, and consequently of available semi-liquid food, seemed to cause them to become dwarfed. It is evident that heat and moisture are required for the normal development of the fly, as they are for nearly all insects.

The maggot molts twice, consequently there are three stage of development, and it becomes sensibly larger at each stage After remaining in the first stage for one day it molts, and differs from the preceding stage only in being a little larger, and i the addition of the spiracle near the head (Figure 28, B, *sp.* C the same enlarged.) After remaining in this stage from twenty four to thirty-six hours it sheds its skin and enters upon th third stage, which lasts three or four days. Figure 28, A, represent the maggot; the body is long and slender, somewh conical, the head and mouth-parts being rudimentary. The e of the body is truncated, and bears two short tubercles or spiracl Figure 28, E, represents one of these circular breathing holes mu enlarged, with three sinuous openings, the edges of which



(FIG. 28.) EARLY STAGES OF THE HOUSE FLY.[1]

armed with fine projections forming a rude sieve for the exclusion of dust and dirt. With these spiracles connect the two main tracheæ, communicating by two cross branches (*a*) and sending off numerous twigs. The young of the house fly differs chiefly from that of the flesh fly in being only one half as large, while the form of the openings in the spiracles at the end of the body is entirely different.

When about to transform into the pupa or chrysalis state the

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[1] A, larva of *Musca domestica*, just hatched, showing the distribution of the two main tracheæ, and the anterior and posterior commissures (*a*, *a*), dorsal view. B, the larva in the second stage; *sp*, spiracle. C, spiracle enlarged. F, head of the same larva, enlarged; *bl*, labrum (?); *md*, mandibles; *mx*, maxillæ; *at*, antennæ. E, a terminal spiracle much enlarged. D, puparium; *sp*, spiracle. All the figures much enlarged.

body contracts into a barrel-shaped form, as seen in Figure 28, D, turns brown and hard, forming a case (puparium) within which the body of the larva transforms into that of the pupa. Weismann has made the discovery that in the larval flesh fly when about to transform into the pupa state, the head and thoracic segments die, and that the head and thorax of the pupa arise from minute disks attached to the smaller nerves or tracheæ in the body of the worm. This is paralleled by the metamorphosis of the "pluteus" into the adult starfish, and is a much more complete metamorphosis than even that of the caterpillar into the chrysalis of the butterfly.

Our house fly having as a maggot lived a life of squalor, immersed in its revolting food, with its new change of form, involving the death of one half its body and the origin of a new head and thorax, with legs and wings, eyes, feelers, and mouth-parts; after a short pupal sleep of from five to seven days pushes off one end of its pupa case, and appears winged, with legs where before there were no traces of feet, and is animated by new instincts and mental traits. It is difficult to realize how striking are the changes, physical and psychological, which the house fly undergoes in the transition from the maggot to the volant, cursorial being which puts a girdle, like Puck, around its little world, — the dining-room or parlor, — and like its mischievous prototype plays all sorts of antics, tasting the sugar, lapping the molasses, now tickling the nose of the sleeping housewife resting from her pre-prandial toils, or adjourning to the library and scraping with its spiny tongue the rich binding of the bookworm's treasures.

If in its winged condition it is one of the most disagreeable features of dog-days, and people wonder why flies were ever made at all, it should be remembered that flies have an infancy as maggots, and the loathsome life they then lead as scavengers cleanses and purifies the August air, and lowers the death-rate of our cities and towns. Thus, while stables and piggeries and filth are tolerated by city and town authorities, the young of the house fly and the flesh and blow fly, with their thousand allies, are doing something towards purifying the pestilential air, and averting the summer brood of cholera, dysentery, diphtheria, typhus and typhoid fever, which descend like harpies upon the devoted towns and cities. It may be regarded as an axiom that where flies most abound there filth, death-dealing and baneful, is most abundant, and filth-diseases such as we have named most do congregate.

As we have said, when the fly leaves its pupa-case it pushes away the front end of the case, which opens like a lid, by means of the distention of the membranous front of the head, which may be seen pushing out and in as the fly walks rapidly about. This bladder-like expansion is evidently distended with air and in connection with the air-tubes within the body, so that it may serve the temporary purpose of enabling the fly to disengage itself from its pupa-case. When free from its prison the fly walks or rather runs nervously about, as if laboring under a good deal of mental excitement, and quite dazed by the new world of light and life about it, for as a maggot it was blind, deaf, and dumb. Now its wings are soft, small, baggy, and half their final size. The fluid that fills them soon, however, dries up, the skin of the fly attains the colors of maturity and it soon flies off with a buzz suggestive of contentment and light-heartedness born of its mercurial temperament. That the fly not only throws off in its buzz songs of the affections, love ditties, but also may vary its notes accordingly as it is elevated or depressed in spirits concerning more trivial and less absorbing matters, we are assured by Sir John Lubbock, who says that the sounds of insects do not merely serve to bring the sexes together; they are not merely "love songs," but also serve, like any true language, to express the feelings.

The life of the house fly may, then, be summed up as follows: It lives one day in the egg state, from five days to a week as a maggot, from five to seven days in the pupa state, — in all, from ten to fourteen days in the month of August, — before the winged adult period. It is often asked how long-lived a fly is. Most of the flies which are born in August live for a month or six weeks, and die at the coming of frost, either of cold or from the attacks of fungoid plants. A few probably winter over and survive until midsummer, and thus maintain the existence of this useful species, to which civilized man owes more than he can readily estimate, and with which he can dispense only when the health of our cities and towns is looked after with far greater vigilance and intelligence than is perhaps likely to be the case for several centuries to come.

THE NATURAL HISTORY OF KERGUELEN ISLAND.

THE reports of Dr. J. H. Kidder, naturalist of the Transit-of-Venus Expedition, on the natural history of Desolation or Kerguelen Island are of interest from two reasons; first, the extreme paucity of life upon this barren rock; and second, the large number of naturalists who have been called upon to report upon the few specimens collected; as many as eight specialists in zoölogy and four in botany, as well as a mineralogist, contributing their aid, while the naturalists of the English Transit-of-Venus Expedition, particularly Rev. A. E. Eaton, assisted by several English and a German entomologist, have also published papers on the entomology of the island.

It will be remembered that the United States ship Swatara, with Dr. J. H. Kidder as naturalist, sailed from New York on the 8th of June, 1874, and landed, September 10th, two astronomers and Dr. Kidder, of the navy, with photographers and two of the crew. Some of the more interesting results we shall present to our readers, often using the language of the reporters. This island is situated southeast of Madagascar, in latitude 50°, longitude 65°, approximately. It is about ninety miles long by fifty in width, and is composed, as to its southern part at least, wholly of volcanic rock, showing no signs of stratification. The northern portion contains stratified rocks, deposits of coal of little value, and very ancient remains of silicified wood, indicating the former existence of trees of considerable size, and the submergence and subsequent upheaval of the land upon which they grew. The whalers say that a large glacier runs across the island, in a generally east and west direction, at about its centre. In the interior the land is mountainous, peaks with sharp volcanic outlines alternating with table-topped hills. Mount Ross, the highest peak (about five thousand feet), is always snow-covered and quite inaccessible. Near the sea, in December, the snow-line was found on Mount Crozier at about two thousand six hundred feet above the sea-level.

Kerguelen Island is a region of almost constant precipitation, only twenty-seven days out of four months being recorded as without snow or rain, and a still smaller number of nights. The thermometer ranged not far from the freezing-point, the daily average being a little below it in September and October, and a little above it in November and December. Whalers say that in midwinter there is no marked increase in the severity of the weather. The lowest temperature recorded was 18° F., and the highest 64°. The island is also deservedly notorious for the violence of the gales which almost constantly prevail, and which often arise with a suddenness that makes it very dangerous to go about in small boats.

These climatic conditions have their natural effect upon the flora and fauna of the island, there being neither tree nor shrub, no plant, indeed, larger than the Kerguelen cabbage, while the very few species of phænogamous plants which do survive are such only as can thrive exposed to sudden and violent alternations of dryness and moisture, and to fierce gales of wind. As a natural consequence of these facts, there are no land-birds or mammals, strictly speaking, indigenous to Kerguelen Island, and but a single shore-bird (*Chionis minor*).

As might be expected, the insects were few in number, and some curious wingless forms were discovered, it being a characteristic of certain island species that they lose the power of flight and the wings themselves, wholly or in part. Several weevils occurred, most of which were incapable of flight, their wing-cases being soldered together. Two small moths with "very imperfect and abbreviated wings" were captured, though unfortunately afterwards lost. But the most interesting forms, evidently due to their singular physical surroundings, are three genera of wingless flies, which present several anomalies not heretofore observed. With the structure of flies, they possess many of the habits of beetles, such as that of counterfeiting death when in danger. One species (*Anatalanta aptera*), which feeds on carrion, has no vestige of either wings or balancers. A second kind, which feeds on the leaves of the Kerguelen cabbage (*Pringlea antiscorbutica*), is of considerable size, dark brown in color, with long legs, and showing considerable activity of movement, looking not unlike large ants. The wings are represented by small scale-like bodies. A third genus (*Amalopteryx maritima*) represents a further step in the progress of development, possessing both wings and balancers, but still unable to fly. Besides these forms, Mr. Eaton mentions a crane fly (a Tipulid) with imperfect or abortive wings. A small gnat was the only flying insect, except a curculio, observed on the island. Even the common house fly had not yet been naturalized.

Among other invertebrates is a species of sea-urchin (*Hemiaster*) which has been found by Mr. A. Agassiz to be viviparous, there being but one other genus (*Anochanus*) known to produce young developing directly into the adult form without the marked metamorphosis usual in echinoderms.

In his able discussion of the structure and affinities of *Chionis minor*, the lesser sheath-bill, or "white paddy" of whalers, Dr. Coues has treated us to one of the most interesting ornithological essays that has appeared during the past few years. This bird is another instance, among the aberrant forms found in this island, of animals "whose structure gives no clew whatever to their habits, so aberrant has been the progress of their variation in the peculiar conditions under which they live." Thus the great southern skua has here adopted the habits of a land-hawk, and the lesser sheath-bill is "a connecting link, closing the narrow gap between the plovers and gulls of the present day. In our opinion, this group represents the survivors of an ancestral type from which both gulls and plovers have descended. And this opinion is strongly supported by the geographical isolation of its habitat, affording but few conditions favorable to variation."

In the practical matter of classification, it is evident that *Chionis* is not exactly referable to either of the two groups between which it stands. A consideration of its external characteristics, its digestive system, or its osteology, solely, would lead to very widely diverse conclusions. For we have presented in this bird a genus with the general appearance, gait, and flight of a pigeon; with the beak and voice of a crow; with the habits of a wader, yet dreading the water; and with the pugnacity and familiarity with man of a rasorial bird. With the last group its digestive system would certainly place it, to say nothing of the long after-shafts of the feathers; and osteological comparison establishes its position definitely between the gulls and the plovers, but rather nearer to the former.

The only land mammal found on the island is the common mouse (*Mus musculus*), which abounds everywhere, and was doubtless imported by one of the early sealers. It builds its nest in holes in sand-banks, lining it with dried grass-stems or bits of oakum, and appears to feed mostly on grass-seed.

The sea-elephant is the most interesting marine mammal. It begins to "haul up" on the beaches of its breeding-places about October 10th, and remains ashore until well into the month of January. The old bulls, which alone are provided with a proboscis, take charge, each, of a large number of females, guarding them from the approach of other bulls, and (so the sealers assert) prevent them from returning to the sea before the young are old enough to do so with safety. During the breeding season the bulls are very pugnacious, fighting fiercely with each other, and even attacking the sealers themselves. Although seemingly so unwieldy, they are described as getting over the beaches with surprising speed, advancing both flippers at a time and using them like crutches. The beaches of Royal Sound are fringed by innumerable wallows — cradle-shaped pits — in which the animals lie during the breeding-season, recalling the buffalo-wallows of our western prairies.

The increasing scarcity of the sea-elephant and the consequent uncertainty in hunting it, together with the diminished demand for the oil since the introduction of coal-oil into general use, have caused a great falling-off in the business of elephant-hunting. The Crozet Islands, for example, have not been "worked" for five years, and at Kerguelen there was only one small schooner engaged in this pursuit, two others making Three Island Harbor their head-quarters, but spending the "season" at Heard's Island, three hundred miles to the southward. It may, therefore, be reasonably hoped that these singular animals, but lately far on their way toward extinction, will have an opportunity to increase again in numbers, and that the sealers may learn from past experience to carry on their hunting operations with more judgment, sparing breeding females and very young cubs. When the Monongahela visited the Crozet Islands on December 1st, they found the sea-elephants very numerous, although left undisturbed for only five seasons.

Besides the sea-elephant, the sea-leopard (*Ogmorhinus leptonyx*) often visits the island, as do several species of seal. The sea-leopard is also sought for its oil, but is less valuable, being a much more active animal, and therefore less heavily loaded with blubber. The king-penguin is said to be its favorite food, a statement which speaks well for the sea-leopard's activity in the water, the penguin swimming rapidly enough of course to catch the fish upon which it feeds. The leopard is described as pursuing and overtaking the penguin under water, rising to the surface and tossing it into the air, so as to catch it more securely, crosswise in its jaws.

RECENT LITERATURE.

Fritsch's Birds of Europe.[1] — This work is by an accomplished zoölogist, the author of an elaborate memoir on the cephalopods of the cretaceous formation of Bohemia, and more recently of a work on the laws of migrations of the birds of Europe, containing "an immense amount of data, which have been worked up most satisfactorily," as stated by Mr. R. B. Sharpe in the Zoölogical Record for 1874. The present work briefly describes the orders, families, genera, and species of European birds, with their most important synonyms and diagnoses, and notes on breeding habits and distribution. These descriptions, conjoined with the chromo-lithograph of each species, — executed in most cases nearly as well as the figures in the United States government reports, but nearly all reduced below the natural size, — will enable one to readily identify any European bird. The classification is perhaps antiquated, beginning with the birds of prey, but the treatment of the subject is that of a skilled ornithologist. It is evidently inferior to Dr. Coues's admirable Key to North American Birds, though we are not sure but that a compact work of this nature, accompanied by an atlas of chromo-lithographic plates and published for fifty dollars, would not be welcomed by amateur ornithologists, though Coues's Key on the one hand, and Baird, Brewer, and Ridgway's magnificent work on the other, leave almost nothing to be desired by the American student who lives in a town or city having in its library Audubon's Birds of America and the government and state reports containing the ornithology of the Western and Pacific States.

Dr. Fritsch's work is highly spoken of by Dr. Hartlaub, Von Homeyer, and a reviewer in Cabanis' *Journal für Ornithologie,* and would form a valuable work of reference in any library.

Riley's Eighth Report on the Noxious Insects of Missouri.[2] — The Colorado potato beetle, the canker worm, the army worm, the Rocky Mountain locust, and the grape Phylloxera receive much attention in this report, and fresh information is given regarding their habits, devastations, and the means of combating them. It is shown by the experiments of Professor Kedzie that Paris green does not poison the soil or become absorbed by the plants, and the reporter insists that, used with caution, it is the best remedy for the ravages of the *Doryphora.* He adopts and extends Walsh's view that this beetle gradually spread to the Atlantic from the "mountain region of Colorado," and in another place (page 10) that "the native home of the species is the more fertile country east of the [Rocky] mountains, extending from the Black Hills to Mexico, where it becomes scarce, and is represented by *Doryphora undecimlineata* and *D. melanothorax*." With this latter view we entirely coincide, but Walsh's idea of its being a mountain-insect is erroneous, as it does not injure the potato fields in Colorado above an altitude of about seven thousand feet, is confined mostly to the plains, and is a subtropical insect, with its allies living on the plains of Mexico, Central America, and New Grenada. He opposes the view, and we think with good reason, that the beetle is poisonous. The reporter shows that the two species of canker worm differ so much in the egg, larva, pupa, and adult state as to belong to different genera. While we should hardly be inclined to separate the two species generically, entomologists are greatly indebted to Dr. Riley for the mass of new facts regarding their specific distinctions which he has presented with pen and pencil.

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[1] *Naturgeschichte der Vögels Europa's.* Von Dr. Anton Fritsch. Prag. 1853–70. Text 8vo, pp. 506, with atlas of 61 plates, folio. S. E. Cassino, Naturalists' Agency, Salem, Mass. $40.

[2] *Eighth Annual Report on the Noxious, Beneficial, and other Insects of the State of Missouri.* By C. V. Riley. 8vo. 1876.

The chapter on the locust affords interesting reading, and contains valuable suggestions as to the best means of withstanding its attacks, for which government aid is invoked. New facts regarding the grape Phylloxera and army worm, and an essay on the yucca borer, also aid in rendering the report one of the most interesting and practically valuable that has yet been issued.

THE ZOOLOGICAL RECORD FOR 1874.[1] — On opening this volume, which has just been received, our attention is drawn to the increasing amount of work done by American zoölogists, which bears a fair proportion to the amount of labor performed by other nations. The recorder of literature on mammalia says that, "as in 1873, special notice is due to the labors of Leidy, Marsh, and Cope, among the remains of the mammals of the American tertiary periods." In the portion on birds the recorders state that "the striking discoveries for the year 1874 are limited in number; but some remarkable books have nevertheless been produced during its course, the chief of which must be reckoned the great works on North American birds by Messrs. Baird, Brewer, and Ridgway, and Coues." The researches of Professor Morse on the Brachiopods, and of Mr. A. Agassiz on the Echini and the embryology of the Ctenophora, are noticed at greater or less length. We repeat what we have before said, that this Record is indispensable to the American zoölogist in particular, as so many live away from scientific libraries, while the working naturalist in scientific centres needs one at hand at all times. We shall be glad when the time comes that fewer new species will have to be recorded, and more attention given by zoologists to the natural history of animals, and consequently a fuller record of how animals act, think, and are mutually related may be presented in such a record of zoölogical discovery as the present. Systematic zoölogy is largely dictionary-work, and preparatory to true biological studies.

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[1] *The Zoölogical Record for* 1874; being Volume Eleventh of the Record of Zoölogical Literature. Edited by E. C. RYE. London: John Van Voorst. 1876. 8vo, pp. 557.

Recent Books and Pamphlets. — A Report on the Invertebrate Cretaceous and Tertiary Fossils of the Upper Missouri Country. By F. B. Meek. (U. S. Geological Survey of the Territories, F. V. Hayden in charge.) Washington, D. C. 1876. 4to, pp. 629. 45 plates.

A Monograph of the Geometrid Moths or Phalænidæ of the United States. By A. S. Packard, Jr. (U. S. Geological Survey of the Territories, F. V. Hayden in charge.) Washington, D. C. 1876. 8vo, pp. 607. With 13 plates.

On the Geology of Portions of our Western Territory visited in the Years 1871, 1872, and 1873. By G. K. Gilbert. (Extracted from vol. iii. of the U. S. Engineers' Reports of Explorations and Surveys west of the 100th Meridian, Lieut. G. M. Wheeler in charge.) Washington. 1876. 4to, pp. 20–187, 506–681.

Report on the Geology of Portions of our Western Territory visited in the Years 1872 and 1873. By Edwin E. Howell. (Extracted from vol. iii. of the U. S. Engineers' Reports, etc.) Washington. 1876. 4to, pp. 231–301.

Birds of Southwestern Mexico, collected by F. E. Sumichrast. Prepared by G. N. Lawrence. (Bulletin of the U. S. National Museum, No. 4.) Washington, D. C. 1876. 8vo, pp. 56.

Classification of the Collection to illustrate the Animal Resources of the United States, etc. By G. Brown Goode. (Bulletin of the U. S. National Museum, No. 6.) Washington, D. C. 8vo, pp. 126.

Zur Naturgeschichte der Daphniden. Von Dr. A. Weismann. I. Ueber die Bildung von wintereiern bei *Leptodora hyalina*. Leipzig. 1876. 8vo, pp. 64. 3 plates.

Report on the Geology and Gold Fields of Otago. By F. W. Hutton and G. H. F. Ulrich, etc. Dunedin. 1875. 8vo, pp. 244.

On a New Crinoid from the Cretaceous Formation of the West. By George B. Grinnell. (From the American Journal of Science and Arts, xii. July, 1876.) 8vo, pp. 3.

Contributions to the Flora of Iowa; a Catalogue of the Phænogamous Plants. By J. C. Arthur. Charles City. 1876. 8vo, pp. 43.

Taxidermy without a Teacher. By Walter P. Manton. Illustrated. South Framingham, Mass. 1876. 12mo, pp. 41. 50 cents.

Annual Report of the Entomological Society of Ontario, etc. Toronto. 1876. 8vo, pp. 54.

The Mineral Wealth, Climate and Rainfall, and Natural Resources of the Black Hills of Dakota. By W. P. Jenney. Washington, D. C. 1876. 8vo, pp. 71.

GENERAL NOTES.

BOTANY.[1]

Notes on Acnida. — Dr. John Mitchell, one of the very earliest of our botanists, in a zoölogical and botanical memoir which he sent from Virginia in 1741 to Sir Hans Sloane, in London, and which Sloane had published soon after in Acta Acad. Nat. Cur., at Nuremberg, characterized the genus *Acnide*. Linnæus, in adopting it, changed the orthography to *Acnida*, for no reason which would now be thought sufficient; but the difference is unimportant. *Acnida cannabina* was the sole Linnæan species.

In Michaux's Flora a second species was characterized, *A. rusocarpa*, with obtuse-angled rugose fruit. This specific name was somewhat puzzling. Willdenow took it for a misprint of *ruscocarpa*; but Sprengel saw that it was meant to refer to the rugose fruit, and therefore should have been written *rhyssocarpa*.

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[1] Conducted by Prof. G. L. Goodale.

The essential characters of the genus are: flowers diœcious; the female achlamydeous.

The true *Acnidæ* are submaritime and have a pretty large and indehiscent utricle, which is somewhat fleshy when fresh. Our botanists on the whole have failed to make out more than one species.

Moquin-Tandon, in De Candolle's Prodromus, in 1849, added a section, *Montelia*, with a more membranaceous, utriculate, and smaller fruit, under which he placed two species, *A. tuberculata*, a new one, and *A. ruscocarpa*, which he took for Michaux's of that name; but the plant he describes is not the one figured in Michaux's Flora, and I suppose is not distinct from Moquin's own *A. tuberculata*. This belongs mainly to the banks of rivers and lakes.

When I published the second edition of my Manual of the Botany of the Northern United States, I had in cultivation, from Fendler's seeds, the *Amarantus tamariscinus* of Nuttall, which I saw had the characters of *Acnida*, sect. *Montelia* of Moquin-Tandon, except that the utricle was circumscissile in the manner of a true *Amarantus*. Whereupon, having adopted *Euxolus*, I followed up Moquin's hint, and set up *Montelia* as a genus, upon what I took to be one polymorphous species; having, by a sad oversight, confounded Moquin's *Montelia*, which has a small and indehiscent utricle, with my *M. tamariscina*, the utricle of which dehisces transversely, and which likewise has far more slender fertile inflorescence.

While correcting this gross mistake, I wish also to direct the attention of our botanists this summer to the coast species of *Acnida*, and to request that specimens be prepared, and also critically examined when fresh, with the view of soon determining whether I am justified in my belief that we have three genuine species on the Atlantic coast, or within reach of tidal water. If my present opinion is well founded as to the species, and as to the extent of the genus, the arrangement should be somewhat as follows: —

ACNIDA (*Acnide* Mitchell) Linn.

(1.) EUACNIDE. Utricle somewhat fleshy, indehiscent, large, *i. e.*, one and a half to two lines long.

A. RHYSSOCARPA, alias RUSOCARPA Michx. Fertile inflorescence very naked; the bracts not half the length of the fleshy utricle, the angles of which are not rarely rugose-tuberculated; stigmas comparatively short and slender-subulate. Salt marshes, New England to Georgia.

A. CANNABINA L. Fertile inflorescence slender or sometimes glomerate; utricle thinner and smaller, with acute and smooth angles, much exceeding the bracts; stigmas very long and filiform, almost plumosely hairy. Salt marshes and river-banks even beyond brackish water, New England to Georgia, West Indies (?), etc.

A. AUSTRALIS, n. sp. (*A. cannabina* Chapman, S. Flora.) Panicled spikes of the fertile inflorescence dense, linear-cylindrical; utricle smooth, thin, hardly at all fleshy, acute-angled, little if at all exceeding the imbricated bracts; stigmas setaceous, rather short. Florida, at Apalachicola, Dr. Chapman; Biscayan Bay, Dr. Palmer, coll. no. 462.

(2.) MONTELIA Moquin-Tandon. Utricle thin and small (half to two thirds of a line long), punctate-rugose or roughish, indehiscent), equaled or exceeded by the cuspidate-tipped bracts; stigmas slender, filiform, almost plumosely hairy.

A. TUBERCULATA Moquin-Tandon, in DC. Prodr. *A. rusocarpa* Moquin-Tandon, l. c., not of Michx. *A. cannabina* var. *concatenata* Moquin-Tandon, l. c. *Amarantus Miamensis* Riddell, synopsis. *Montelia tamariscina* Gray, Man., Bot. ed. 2, 370, and ed. 5, 413, partly, especially the var. *concatenata.* River-banks, shores, etc., in the interior. Lake Champlain to Iowa and Texas. Sometimes erect, and from one to four feet high, sometimes spreading or prostrate in sandy or gravelly soil.

(3.) PYXIDI-MONTELIA. Utricle thin and small, shorter than the cuspidate-tipped bracts, circumscissile in the manner of true *Amarantus;* fertile inflorescence in slender virgate paniculate spikes, less glomerate than in the preceding; stigmas similar or shorter.

A. TAMARISCINA. *Amarantus tamariscina* Nutt., in Trans. Am. Phil. Soc., n. ser., v. 165. *Montelia tamariscina* Gray, l. c., in part. Arkansas to Texas and New Mexico.

Our botanists along and near the seaboard are particularly requested to examine the species they meet with, and to send good fruiting specimens to the writer. The distinctions between *A. cannabina* and *A. rhyssocarpa* should be especially looked after. The fruit of the former is hardly to be found in any of our larger herbaria. Florida specimens of any *Acnida* are much desired. So also are fertile specimens of any from Arkansas and Texas, especially of *A. tamariscina.* Nuttall's specimens of this are not even in flower, so that he was unaware that the plant was diœcious and the fertile flowers achlamydeous. Although the plant is common in Texas, ripe fruit is little known. — ASA GRAY.

LARGE ELM. — In the second and admirably illustrated edition of Mr. Emerson's classical report on the trees and shrubs of Massachusetts, most of the notable elms in the State are enumerated, and measurements given. But one of the noblest, though by no means the largest, of them, to which the writer was recently introduced, is not upon the record. It is in Boxford, Essex County, not far from the eastern border of Andover, a stately tree, with a girth of nineteen feet at the smallest part of the trunk below the limbs, and a full top in good condition, except that a few of the uppermost limbs are perishing in the manner of the species. — ASA GRAY.

CALLUNA VULGARIS, THE LING OR HEATHER, REDISCOVERED IN MASSACHUSETTS. — The now well-known patch of *Calluna* in Tewksbury, which was discovered by Mr. Jackson Dawson nine or ten years ago, was then the only one known in the United States or, indeed, on the continent. Up to this time the only contradiction to the current aphorism, "There are no heaths in America," came from Newfoundland, where *Calluna* was known to occur, although few botanists had ever seen specimens. It required some hardihood, as well as a clear conception of the causes which have ruled over the actual distribution of our species in former times, to pronounce that this Tewksbury patch of heath was indigenous. The discoveries, soon afterwards, in Nova Scotia and Cape Breton still left a wide hiatus. This was partially bridged over by the detection by Mr. Pickard, a Scotch gardener, of a similar very restricted station in Maine, on Cape Elizabeth, near Portland. We have now the satisfaction of recording a second station in Massachusetts, not far from the former one. Mr. James Mitchell, of Andover, is the present discoverer, and the station is in the western part of Andover, half a mile northeast of Haggett's Pond, and five miles north of the Tewksbury station. Mr. Mitchell accidentally met with this patch last summer, when berrying, and, being a Scotchman, recognized it, took home a sprig of it, and at a subsequent visit grubbed up one or two small plants, which a neighbor still has in cultivation. A fresh branch taken by him from the wild plants this summer is now before me. It proves to be of the green and smoothish variety of *Calluna*, precisely like the Tewksbury plant. Small as the new patch is said to be, "it will serve" to confirm the opinion long ago expressed; for a second station greatly diminishes the very small chance of its having been casually or in any way introduced through human agency. It should also be noted that this station, as I am informed by the Rev. Mr. Wright, is near by an extensive glacial moraine which traverses that district, and which he has traced for a great distance northward. — ASA GRAY.

HETEROMORPHISM IN EPIGÆA. — The May-flower, being more largely gathered and brought under our notice than any other wild blossom — at least in the Atlantic States — should be well known in all the details of structure. But it hardly is so. The structure of its stigma was first well described in the fifth edition of my Manual of the Botany of the Northern United States, and the likeness to *Pyrola* suggested. I suppose that this likeness is really one of relationship, but not of a near degree, as most other points of similarity are wanting. From the difference in the stigmas of different flowers, I was disposed to think that the five lobes lengthened and protruded with age, in the manner of *Pyrola;* but this does not prove to be the case. In all cases, however, the apex of the style is as it were hollowed out or extended into a ring, with a five-crenate border, to the inner face of which the five stigmas are adnate, each before one of the small teeth or lobes, and extending sometimes slightly beyond it, but remaining short and erect, sometimes much beyond and radiately expanded.

In Michaux's Flora is the note "Flores omnes in nonnullis individuis abortivi," and botanists are generally aware that fruit is seldom met with. The flowers have been said to be unisexual (diœcious); but all appear to have well formed ovary and ovules, although some individuals were known to want the stamens. Professor Goodale, knowing a station in Maine in which *Epigæa* year after year sets fruit, kindly procured from thence a large number of fresh specimens; and these I have now examined in regard to stamens and pistil. They show the following heteromorphous condition of things.

(1.) About ten per cent. of the specimens have a style considerably longer than the stamens, raising the stigmas a little out of the throat of the corolla, in which the anthers are included: the stigmas are cylindraceous, radiate like the spokes of a wheel, half a line in length, therefore strongly projecting, moist and glutinous, and evidently in good condition for fertilization. The anthers in these flowers are slender, commonly withering without dehiscence, and containing few, yet perhaps well-formed, pollen-grains. The fruiting specimens gathered at the same station in former years all evidently belong to this form, as the persistent style and long stigmas show. One or two specimens of this form manifest a disposition to convert their anthers into petals; but this is occasionally seen in other forms.

(2.) A smaller number of specimens show the stigmas of the preceding on a shorter style, sometimes so short as to place the radiating stigmas as low as the middle of the tube of the corolla, sometimes bringing it nearly up to the throat. In one instance a short-styled flower was detected in a cluster of flowers otherwise of the character of No. 1. These short-styled blossoms, instead of having more conspicuous or higher anthers than in the long-styled, bear them either at the same proportional height and in the same condition, or bear mere rudiments of anthers, or not rarely none at all, and even the filaments are smaller, abortive, or occasionally altogether wanting. This sometimes happens in No. 1 also.

(3.) The larger number of flowers, perhaps three-fourths of the specimens under examination, have the long style of No. 1, an ovary equally well-formed and ovuliferous, but either rather smaller or not going on to grow; but the stigmas are short, only slightly projecting beyond the lobes of the cup to which they adhere, in all stages erect, and comparatively smooth and dry. Their tips, however, appear somewhat papillose under a strong lens, and grains of pollen placed thereon incline slightly to adhere, yet not so much as upon the surface of the style far below, which gets well covered with pollen from the contiguous anthers. The difference between these stigmas and those of the foregoing forms is striking and constant, no gradations between them having been detected. The anthers abound with pollen, and are dehiscent at or a little before the opening of the corolla.

(4.) A considerable number of such flowers have a shorter style, so that the stigma stands as low as the base of the five longer anthers, in one or two even lower than all the anthers; otherwise all is as in No. 3, of which this seems to be a mere variation. And here also, although not very definitely, there is a tendency to having lower instead of higher anthers in connection with the short style.

The flowers of *Epigæa* may therefore be classified into two kinds, each with two modifications; the two main kinds characterized by the nature and perfection of the stigma, along with more or less abortion of the stamens; their modifications, by the length of the style. The first is leading to dioicism, the second points to dimorphism. I am not aware that either unisexual or dimorphous flowers are otherwise known in the *Ericaceæ*. Dimorphism (as exemplified in primroses, *Houstonia*, and *Mitchella*) may be regarded as the more perfect arrangement on the score of economy, as it secures cross-fertilization along with fertility of all the flowers. It would seem as if this had been attempted in *Epigæa*, but that the stamens did not respond with the requisite correlation to the long and short styles; and the same may be said of certain flowers in one or two other families. Of dichogamy, the other equally economical method, I find no indication in *Epigæa* blossoms. But they appear to be now falling back upon the remaining, less economical mode of securing the end, namely, by unisexual blossoms.

It would be interesting to know whether the small-stigma forms of *Epigæa* are ever fruitful, or fully so. It might not be difficult to ascertain the kind of flower in any case which has matured fruit; for the style and stigmas persist until the capsule is well formed in the fruit thus far known.

The æstivation of the corolla is that of the tribe, imbricated, but with a strong tendency to convolute; more commonly there is only one exterior and one interior lobe.

In reproducing from the *American Journal* this account in the NATURALIST, I have a special object, that of having search made this summer for fruiting specimens of all sorts. I should be glad to receive the fruit from various parts of the country, in order to ascertain, if possible, whether the short-stigma blossoms ever set seed, — as it seems likely they may, — and whether the seeds or capsules show any differences. In collecting and preserving fruiting specimens, care should be taken not to detach the style. — ASA GRAY.

BOTANICAL PAPERS IN RECENT PERIODICALS. — *Comptes rendus*, April 24th. Boussingault, On the Growth of Plants which have no Chlorophyll. Frémy and Dehérain, Researches in regard to the Sugar Beet. May 8th. Pasteur, Notes respecting Fermentation.

Flora, No. 14. Dr. Velten, The relation of Temperature to the Movement of Protoplasma. A. de Krempelhuber, Brazilian Lichens. No. 15. Dr. Chr. Luerssen, Notice of Wawra's Vascular Cryptogams. W. Nylander, New European Lichens.

Botanische Zeitung, No. 19. W. Velten, On Electricity in Plants. No. 20. Ascheron, Phytographic notices. No. 21. Ascheron, On Malaguetta Pepper. No. 22. Areschoug, On certain Rubi. No. 23. De Borbás, Conspectus of doubtful species of Dianthus. No. 24. Philipi, On Sandal-Wood of Juan Fernandez. On Primula pistiifolia, Gris. No. 25. Reuther, On the development of the flower. No. 26. Continuation of the last. In the above numbers there are several interesting reports of scientific meetings which will be hereafter noticed.

ZOÖLOGY.

A TRUE "SNAKE STORY." — The article in the March number on "A Snake-Eating Snake" recalls to memory an incident which occurred to me last year, showing that such reptiles are found nearer home than Costa Rica. In walking through a cañon about two miles east of Oakland, Cal., one spring morning, I met with a fine specimen of the California milk-snake (*Lampropeltis Boylii*, figured in Pacific Railroad Report as *Coronella balteata*, x. 14, Plate V). Having disabled it by a blow across the back, I wrapped it in paper and put it in a bag, intending, when I sat down to rest, to skin it, and to examine the contents of its much-distended stomach. About noon I opened the paper and was not a little startled to find that my milk-snake, so strongly characterized by alternating belts of black and white, was apparently transformed into a garter-snake of about the same size, with longitudinal stripes.

The first impression was that I had got hold of one of the deceiving tribes of the "old serpent" himself, but recalling the scientific coolness with which Cuvier is said to have confounded him when under the disguise of horns and hoofs, I ventured to look closer, and found that the garter-snake must have been swallowed whole by the milk-snake, which, on recovering from the stunning blow I gave, had disgorged its prey, and then succeeded in crawling through a hole in the bag. All this would not have seemed so strange if the two snakes had not been so nearly of a size that I did not at first notice any difference. As I recollect, the garter-snake was over two feet long, but being damaged, and a common species, I did not preserve it. I had not captured any of the kind recently, nor any other snake except the milk-snake. — J. G. COOPER, M. D.

"THE BANK SWALLOW" AGAIN. — Regarding the instance in which Dr. Haymond observed a "bank swallow" carry building material into an auger hole, as communicated to the June number of the NATURALIST by Dr. Coues, it may be fairly questioned whether the species was not the rough-winged swallow (*Stelgioöpteryx serripennis*), which is much more common in many parts of the country, particularly in the Mississippi Valley, than the other species. The habits and appearance of the two birds are so similar that they are very often confounded, even by good and experienced observers; besides, it is well known that the rough-wing often does build about bridges and in such situations as that described by Dr. Haymond. — R. RIDGEWAY.

THE GREEN SNAKE IN NEW MEXICO. — It may be interesting to mention an increase of geographical range for the common green snake (*Cyclophis vernalis*). It was found in 1874 at Abiquin, New Mexico, in the valley of the Chama, by Dr. O. Löew, and in 1875 by Lieut. W. L. Carpenter, U. S. A., in Moreno Valley, Northern New Mexico, and again at the head of Ponil Creek, Northern New Mexico. Lieutenant Carpenter also states that the species is by no means uncommon in Southern Colorado. — H. C. YARROW.

ANTHROPOLOGY.

NOTES ON THE STONE IMPLEMENTS FROM ARKANSAS, AT THE PHILADELPHIA EXHIBITION. — In the building erected by the State of Arkansas for the purpose of exhibiting the various resources of that commonwealth is a small but very beautiful series of stone implements, all of which, as I was there informed, were taken from various mounds in Garland, Montgomery, and Saline counties. While the various common forms of implements are all represented by excellent specimens, there is a noticeable preponderance of certain patterns which in other localities are less abundant than allied forms. For instance, the polished celts, of sizes suggesting the ax, rather than a skinning knife, are numerously represented, while but few specimens of the more common grooved ax are in the collection. Whether this preponderance of large celts, as compared with grooved axes, obtains throughout the territory from which these specimens were brought, I could not learn. Certainly, in the Eastern and Middle States the grooved axes are more abundant than celts of the same average size. The spear and arrow points are represented by a series which for beauty of material — they are all chipped from novaculite — and delicacy of workmanship far surpass any similar forms that I have seen. This perfection of the art of flint-chipping is alike in the spear-heads, six and eight inches in length, and the smallest of the arrow-points, scarcely more than half an inch long. The pestles are all cylindrical, and not with a flaring end, as is common to this form of implement in many localities. Of rude implements but few specimens are shown, and none with that weathering of the surface and roughness of chipping characteristic of the rude implements found in New Jersey, more especially in the valley of the Delaware.

Two specimens of a stone implement are shown which are believed to have been used in the cultivation of Indian corn. They certainly bear considerable resemblance to an ordinary plowshare, and doubtless could be used, if attached to a wooden handle, as a rude hand-plow, in light, sandy soils. The specimens bear marks of use upon them, and being found, as I am informed, in mounds, associated with undoubted relics, must be considered to be such, even though the conjecture as to their being plows be far from the truth. The pottery is represented by several fragments of large jugs or vases, which are very elaborately ornamented; more so, I believe, than is usually the case, even with the earthenware of the mound-builders.

There is one roughly fashioned specimen of perforated stone, which would at first glance be looked upon as a poorly made chungkè stone. I call attention particularly to it because in the exhibit from the Cape of Good Hope there is a fac-simile of this Arkansas specimen, which, the commissioner from the Cape says, is a root-digger; a wooden handle is inserted in the perforation of the stone, and it is then used to drag away the earth from long tubers, in order that they may be gathered without fracture. May it not be that some of these rude chungkè stones, especially those that are small and not polished, were used thus, and not for playing the game which has given a name to perhaps more than two forms of stone implements? — CHAS. C. ABBOTT, M. D.

STONE IMPLEMENTS FROM OHIO, AT THE PHILADELPHIA EXHIBITION. — The collections here brought together, and very conveniently arranged, occupy fourteen large cases, and give an excellent idea of the proficiency in flint-chipping attained by the aboriginal peoples of that State. Of the arrangement of the great number of specimens here exhibited, but one word other than of praise need be said. Would it not have been better to separate the surface-found or Indian relics from such as are referable to the mound-builders; or is this indeed impracticable?

Without further comment on the exhibit itself, which is so highly creditable to those having it in charge, I desire to make some comparative notes upon it, with reference to the allied and identical forms of stone implements found in New Jersey.

The display of arrow and spear heads is very complete. In comparison with those from New Jersey, the large number of specimens with serrated edges in the Ohio collection is very noticeable. They are not at all abundant in New Jersey; and the same may be remarked of the twisted or "rifle" arrow-points, of which there are a number on exhibition. Every type, both American and European, is well represented, and the gradation into spear and javelin heads is well shown. Of these larger forms, many are truly magnificent specimens of flint work, and compare well with the best specimens of Danish implements of the same pattern.

The exhibit of grooved stone axes, like that of the arrow-heads, is very large. They vary but little in pattern, but considerably in size, the largest specimen weighing sixteen and a half pounds. These axes are in all respects identical with those from New Jersey, the one difference in the series being a comparative absence of those not having the groove extending entirely around the specimen. The majority of stone axes found in New Jersey certainly are of this pattern.

The pestles exhibited are mostly short and flaring at the grinding ends, a form very rarely occurring in New Jersey.[1] Of drills, rimmers, or borers, whether for drilling in stone or merely perforating leather, the exhibit is very large and the specimens remarkably perfect, considering the delicate shape of the implement. While they do not differ from those found in New Jersey, they are of greater excellence of workmanship, as compared with those now found here; but it is not improbable that the longer time that the eastern specimens have been exposed to the rough usage of the plow, and their being found in stony fields usually, has caused the destruction of all but the stronger and ruder specimens in New Jersey. The same remarks are applicable to the scrapers in the Ohio collection. They do not differ from those found along the Atlantic coast. The series of pipes exhibited is a very attractive feature of the collection; and here, perhaps more than elsewhere, the commingling of Indian and mound-builders' relics is noticeable. Considering all that have the outlines of animals as those of the latter people, the other specimens show a much greater variety of shapes than the writer has as yet found in New Jersey; space will not permit us to give further details as to the various forms of stone implements exhibited, such as gorgets, charms, and animal-carvings. These differ in no way from similar ones found in New Jersey, if we consider the outlines of animals graven on stone as the work of the mound-builders.[2] Taken as a whole, the collection shows a somewhat greater proficiency in the art of working in stone, *with stone*, than would be demonstrated by a like series from New Jersey, and would point to a lower condition of the Atlantic coast tribes; but the difference is more apparent than real; for if eastern specimens of jasper, chalcedony, and quartz implements only are exhibited, we shall find about equal skill in flint-chipping; and it is only implements made from such minerals that are shown in the Ohio collection. It must be borne in mind, too, that a proportion, perhaps very large, of these beautiful spear and arrow points are the production of mound-builders. It is therefore an unwarrantable conclusion that the red Indians lost something of their skill in fabricating stone implements, as they wandered eastward. Leaving out of mind the mound-builder, is there anything to show that the Indian was ever more advanced in culture than he was when first known to the European? On the other hand, is there not much to indicate that he was at one time far less so? — CHAS. C. ABBOTT, M. D.

ANTHROPOLOGICAL NEWS. — The Ninth Annual Report of the Trustees of the Peabody Museum of American Archæology and Ethnology is just issued from the Cambridge press. In addition to the usual information concerning the government and finances of the museum, we have the report of the curator, Mr. F. W. Putnam, upon the condition of the specimens and the additions. The most valuable gifts are from Mr. Alexander Agassiz and Mr. Paul Schumaker. Other contributors of objects and books are mentioned. The curator acknowledges the gratuitous services of Messrs. Lucien Carr and Ernest Jackson. The noticeable feature of the report is the photographs of Mr. Peabody and Dr. Jeffries Wyman, and the index to all the Reports to date. All of them are to be bound into a Centennial volume, in compliance with a call made "upon the public institutions and societies in the United States to furnish some account of their rise and progress," etc.

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[1] A magnificent specimen of this form is exhibited in one of the cases of the Rhode Island display, which, though small, is very interesting.

[2] It is very probable that some three or four specimens of well-drawn animals are not genuine; as certainly two or three of the ornamental axes of striped Silurian slate are very modern.

In *Bulletin de la Société de Géographie*, April, 1876, pages 401–438, V. Derrécagaix gives an extended notice of the Basques, which race the ethnologists of Europe regard as a connecting link between the prehistoric races and the earliest historic tribes of France and Spain.

In the *Comptes rendus de l'Académie des Sciences de l'Institut de Bologne*, J. Capellini publishes an article upon pliocene man in Tuscany. After an extended argument to identify the glacial epoch with the pliocene in Tuscany, the learned author finds the evidence of man's existence in the occurrence of notches and gashes in dorsal apophyses of the *Balænotus*, a species of cetacean, that he supposes to have been made by human agency, and with stone implements. P. Cazalis de Fondouce replies, in *Matériaux*, that while there seems to be evidence of the existence of a tertiary man, M. Capellini's proof is not conclusive, for the incisions in the *Halitherium* of Pouance are known to have been made by the *Carcharodon megalodon*, the dents and gashes in the bones found in the marl beds of Liognac were made by the *Sargus serratus*, and those in the bones from Saint-Prest by the *Canodontes Boinsvilletti*.

Number 5 of *Matériaux* comes to us with an interesting array of matter. The following are the principal articles: History of Quaternary Mammals in France, by J. Gaudry. The Discovery of a Human Station of the Neolithic Period, near Belfort, by Charles Grad. Flint Arrow-Points from the Gironde in the Collection of M. L. Lalanne, by E. Cartailhac. Studies upon the Primitive Races of Russia — The Meriens, by Count Ouvaroff. Celtic Tribes known to the Greeks anteriorly to the Third Century B. C., by M. Mazard. Upon a Station of the Stone Age at Basseville, near Clamency (Niévre), by Darlet.

At the meeting of the ethnological section of the Russian Geographical Society, May 13th, M. J. Venieckoff read a report of the special commission charged to examine into the proposal to publish in an abridged form all the information that has appeared in foreign literature, especially English, on Upper Asia. The committee, while heartily approving of the idea, has suggested that a catalogue of books and articles relating to that region and its inhabitants should be published in the

Proceedings of the society, with an introductory essay on the geography and ethnography of the country, together with accurate maps.

In the Proceedings of the Royal Geographical Society, April, 1876, there is a review of Thompson's Marco Polo's Six Kingdoms or Cities in Java Minor identified in Translations from the Ancient Malay Annals.

The Museum of Ethnology at Leipzig, founded upon the magnificent collections of Dr. Klemm, of Dresden, has published its third annual report, containing the reports of the treasurer and of the trustees, and a list of the members and of the additions during the year.

Friederich von Hellevald, who has just succeeded Dr. Peschel as editor of *Das Ausland*, is engaged in compiling a geography on the principles adopted by Élysée Reclus in his Géographie Universelle. The work, which is to appear in fifty numbers, is entitled Die Erde und ihre Völker, and is to be published at Stuttgard, by W. Spemann & Co.

The American Association for the Advancement of Science will meet at Buffalo, August 23d; a subsection of anthropology will then be formed. Immediately afterwards, September 4th, the International Convention of Archæologists will meet in Philadelphia, where the finest display of American antiquities ever brought together is on exhibition in connection with the Centennial. The British Association will meet at Glasgow, September 6th. The International Congress of Anthropology and Prehistoric Archæology will meet at Buda-Pesth, 4th to 11th of September. The French Association will meet at Clermont-Ferrand, August 19th. The annual meeting of the German Anthropological Society will be held in Jena from the 9th to the 11th of August. — O. T. MASON.

GEOLOGY AND PALÆONTOLOGY.

EXPLORATIONS BY WHEELER'S SURVEY. — In Mr. Gilbert's report we find an interesting chapter on the Colorado Plateau, which lies between the Rocky Mountain system and the Basin Range system at the east and west, and stretches northward to the Uintahs. The simplicity of its structure, he says, the thoroughness of its drainage, which rarely permits detritus to accumulate in its valleys, its barrenness, and the wonderful natural sections exposed in its cañons, conspire to render it indeed "the paradise of the geologist." Mr. Gilbert's studies supplement those of Newberry, Marcou, and Powell. This mountain system resembles the Appalachian in the absence of any great central axis, and in the general tendency to uniformity throughout, but differs widely in other respects. "In the Appalachians corrugation has been produced commonly by folding, exceptionally by faulting; in the Basin Ranges commonly by faulting, exceptionally by flexure." He believes that in the Appalachians the primary phenomena of mountain-building are superficial, and that in the Basin Ranges they are deep-seated, the superficial being secondary; that such a force as has crowded together the strata of the Appalachians, whatever may have been its source, has acted in the Basin Ranges on some portion of the earth's crust beneath the immediate surface; and the upper strata, by continually adapting themselves, under gravity, to the inequalities of the lower, have assumed the forms we see. The geology of the Great Salt Lake is discussed at length, and in a way to excite fresh interest in the history of this wonderful lake.

MEEK'S INVERTEBRATE FOSSILS OF THE UPPER MISSOURI. — This splendid quarto volume has just been issued as volume ix. of the final reports of Hayden's United States Geological Survey of the Territories. It relates chiefly to fossil shells of the cretaceous and tertiary formations of the head-waters of the Missouri, which were largely collected by Dr. Hayden early in his explorations in the West. The different divisions of the cretaceous and tertiary formations of this region were originally established by the invertebrate remains herein described, and it therefore forms the basis of our knowledge of two of the most important formations in the West. As one of the series of volumes issued by the survey, and following those of Leidy and Cope on the fossil mammals, and of Lesquereux on the fossil plants, it contains a large mass of facts contributing toward the solution of one of the most difficult problems in western geology, namely, "the relations of the Lignitic group to the well-defined cretaceous formation immediately beneath it." The discussions by Mr. Meek of this vexed question will interest geologists. The work is illustrated by forty-five plates, with six hundred and twenty-nine pages of text; and from the carefully elaborated introductory essay, the full discussion of synonymy, the careful and detailed descriptions of the genera as well as species, it is evident that the work will add to the high reputation of the distinguished author, and be a classical contribution to American palæontology.

A FOSSIL SKUNK FROM THE BONE CAVES OF PENNSYLVANIA. — In a recent paper on the Dental and Cranial Characters[1] of *Mephitis*, Dr. Coues has described a supposed new species of fossil *Mephitis* from the bone caves of Pennsylvania, and has given detailed descriptions of the skulls and dentition of the different genera of this group. The *Mephitinæ*, embracing the "skunks," is, as is well known, restricted in its distribution to the two Americas, and its representatives are also known to be among the most variable, both in osteological and external characters, of American mammals. In speaking of the common skunk (*Mephitis mephitica*), Dr. Coues says that he is acquainted with no animal that varies more than this, and few that exhibit such remarkable differences, independently of age and sex. "Some specimens," he says, "are a fourth larger than others, and twice as heavy; and there is a corresponding range in contour. Compared with an ordinary ratio of osteological variability, the discrepancies are almost on a par with those exhibited by the coloration of the animal when set over against the more constant markings of most animals." These variations are described somewhat in detail, in connection with a general description of the cranial characters of the species.

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[1] On the Cranial and Dental Characters of Mephitininæ, with Description of Mephitis frontata, n. sp. foss. By Dr. Elliott Coues, U. S. A. Bulletin U. S. Geological and Geographical Survey of the Territories, Second Series, No. 1, pp. 7–15. Washington: Government Printing Office. 1875.

Dr. Coues recognizes among the *Mephitinæ* the three genera *Mephitis*, *Spilogale*, and *Conepatus*. The two first named differ not at all in their dental formulæ, while *Conepatus* has usually been considered as lacking the minute first premolar present in the others. Dr. Coues, however, affirms that it is present as a rule, though always minute, but is often either deciduous or abortive, and never functionally developed. Hence the main differences appear to relate to the general contour of the skull, for while Dr. Coues has described each form with great detail he has failed to give a contrasted summary of the differences that severally characterize these so-called genera, — an omission that detracts considerably from the availability of an otherwise excellent paper. While *Mephitis* and *Spilogale* seem to be hardly generically separable, *Conepatus* presents wider differences, especially in respect to the characters of the lower jaw.

No synonymy is formally presented in this connection, but it is mentioned incidentally that the *M. occidentalis* of authors is inseparable from *M. mephitica*. Of *Mephitis* proper only the single recent species *mephitica* is mentioned; of *Spilogale*, a single species only is noticed, *putorius* Linn., based on Catesby (= to the *M. Zorilla*, *bicolor*, and *interrupta* of recent authors), and of *Conepatus* also but a single species (*marputio* Gmel. = *mesoleuca* Licht.).

The supposed new fossil species here described seems to present no very tangible features. Its size is stated to be intermediate between various specimens of the recent *M. mephitica*, the only ostensible characters hence being the excessive tumidity and angulation of the vertex of the skull, and the vertical narrowing of the zygoma anteriorly. In view of the normal tumidity of the frontal region, and especially the tendency, so readily seen in any large series of the skulls of the common species, to a diseased and abnormal enlargement of this part, this alleged character has much less weight than it would otherwise have.

GEOGRAPHY AND EXPLORATION.

THE ISTHMUS OF TEHUANTEPEC. — We extract the following account from Sumichrast's notes on the birds of the isthmus in the fourth Bulletin of the United States National Museum. The contraction of the American continent between the ninety-fourth and ninety-fifth degrees of longitude west from Greenwich forms what is called, quite improperly, perhaps, the Isthmus of Tehuantepec, whose width between the mouth of the Rio Coatzacoalcos and the Bay of Ventosa is about one hundred and eighty miles.

In a physical point of view, the isthmus may be considered as divided into three parts: first, an eastern, extending from the Gulf of Mexico to the Puerta; secondly, a central, from the Puerta to the Chivela; and thirdly, a western, from the Chivela to the Pacific. The eastern part, formed principally of alluvial land and watered by the Coatzacoalcos and its affluents, has its largest portion covered with thick and damp forests, whose vegetation rivals the greatest beauties of tropical nature. The central region presents an undulating surface, embossed with innumerable *lomas*, or hills, which, rising gradually, unite on the western side with the mountains of the Sierra de los Mijes, and toward the east with those of the Sierra de Chimalapa. Although watered by numerous streams, it presents, nevertheless, but a scanty vegetation, essentially characterized by oaks on the side of Sarabbia, and palm-trees on the plateau of Chivela. The western division, or plains of the Pacific, is very dry, and its vegetable physiognomy presents a striking contrast to the rich plains on the Atlantic slope. Of the few rivers which flow through it, the most important are the Tehuantepec, Juchitan, Chicapa, and Ostula. These are so low during part of the dry season that the inhabitants of the villages and *ranchos* situated on their banks have no drinking-water but that which they draw out of holes dug in the sand.

RESOURCES OF THE BLACK HILLS. — In Mr. Jenney's Mineral Wealth, Climate, etc., of the Black Hills of Dakota, we have an apparently authentic account of the natural resources of this region. Compared with some of the world-renowned districts in California and Australia, the placers at present discovered are not remarkably rich, yet there are claims already opened and worked which are yielding a very good return for the labor employed. The reporter adds that the climate of the Black Hills is wonderfully healthy and invigorating, and that wood, water, and grass are everywhere abundant and of the best quality. "There is gold enough to thoroughly settle and develop the country, and, after the placers are exhausted, stock-raising will be the great business of the inhabitants, who have a world of wealth in the splendid grazing of this region."

SIBERIAN EXPLORATION. — Drs. Finsch and Brehm and Count Waldburg Zeil arrived at Ekaterinburg, April 5th, on their way to Siberia. Dr. Nordenskiöld's plan for following up his voyage of last summer from Norway to Siberia, is to start from Gothenburg July 7th, in a steamer capable of taking 10,000 *puds* weight of cargo. He will go up the Yenisei to Dudinko, and there take in cargo and return by the same route to Norway. The Russians on their part propose despatching a vessel from Yeniseisk down the river by way of the Sea of Kara and the North Sea, to St. Petersburg. The Society for the Encouragement of Russian Sea Trade have also commissioned Messrs. Dahl and Randsen, two experienced seamen, to make a detailed survey of the Obi Gulf and estuary.

EXPLORATION IN NEW GUINEA.—This great island offers one of the most promising fields at present open to the explorer, as its interior is still an absolute *terra incognita.* The ill success of Mr. Macleay's attempt to penetrate the interior by way of Fly River, was due to the unfavorable season of the year. Mr. O. C. Stone has been more successful, as he ascended the Mai-Kassa River, discovered and named by him the Baxter River, in the cooler season. The banks are sparsely populated, the natives being cannibalistic at times in their tastes. In his account of his adventures in the Ellengowan, a steamer of eighty tons, he describes the dugong, kangaroos, Megapodius (one of the nests of these fowl being ten feet high by ninety in circumference), birds-of-paradise, large snakes, and the vegetation of the shores. To the naturalist and botanist the shores of the Baxter River present features of rare interest when we take into consideration the comparative immunity from danger, combined with the ease with which they may be approached, both being considerations of no small importance. That the southern part of New Guinea is either cut up into a series of islands, or intersected by rivers and streams of considerable length, is beyond doubt.

At the meeting of the Royal Geographical Society, held May 8th, Mr. Stone read a paper on The Country and Natives of Port Moresby, New Guinea, and a paper on The Natives and Products of Fly River, New Guinea, by Signor L. M. D'Albertis. Sir Henry Rawlinson hoped that a "Cameron" for New Guinea would soon turn up, and that Mr. Young would be the coming explorer, and would force himself into the large and comparatively unknown regions of New Guinea.

MICROSCOPY.[1]

POLARIZATION OF LIVING TISSUES.—A correspondent of *Science Gossip* has recently noticed that the tissues of a living shrimp are affected by the polariscope, giving most beautiful colors, which cannot be obtained by using the flesh after it has been boiled, and he desires to know whether any one else has observed this. Rev. E. C. Bolles, of Salem, Mass., has been accustomed for years, in his popular lectures on the microscope, to demonstrate this by exhibiting upon the screen small crustaceans or aquatic larvæ, illuminated by polarized light; and a finer screen-effect can hardly be conceived than the flashes of color that play over the large and well-defined image of the muscular fibres at every contraction connected with the movements of the living animal.

ARRANGING DIATOMS. — Dr. G. C. Morris, of Philadelphia, arranges diatoms with facility and success, by using the mechanical stage as a means of holding and moving the bristle which handles the diatoms, while the sub-stage prolonged upwards (through the opening of the regular stage) by means of a tube, serves as a stage to hold the object slide. An arm, attached by means of a socket to the stage, carries a small cork, through which is passed a needle, and the bristle is fastened to this needle in such a manner as to project about a quarter of an inch beyond its point. With this arrangement the objective can be readily focused upon the bristle-point, which can then be moved in any horizontal direction, while the object can be brought up to focus, or depressed below it, by means of the rack of the sub-stage.

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[1] Conducted by DR. R. H. WARD, Troy, N. Y.

A COMPACT COLLECTING CASE. — Mr. Kinne recommends the small leather pocket-cases used by physicians, as being convenient collecting cases, when only small quantities of microscopic objects are to be obtained.

WYTHE'S AMPLIFIERS. — Rev. J. H. Wythe, M. D., reported his experiments with amplifiers, at a recent meeting of the San Francisco Microscopical Society. Believing that late improvements in objectives had rendered it unreasonable to expect greater perfection in them than their present excellence furnishes (a conclusion which we can mention only under protest), he was led to look for future progress mainly in the eye-piece, or in intermediate arrangements of lenses. Having had no opportunity to use or examine the "amplifiers" mentioned in the journals, or the aplanatic searcher of Dr. Pigott, which is often used for a similar purpose, he had experimented independently upon the subject during the last two or three years. He arranged a strongly-magnifying eye-piece, consisting of a deep convex meniscus, in place of the ordinary field lens of the Huyghenian eye-piece, with good results. Afterwards he placed the amplifying lens below an ordinary negative eye-piece, using first a cylindrical lens of conical shape, with the lower and smaller end concave and the upper and larger end convex, and subsequently a double concave lens of 1½ inches virtual focus. This last arrangement was most satisfactory, and seems to correspond somewhat to amplifiers used in the Eastern States. It is described, however, as increasing the amplification from four to eight times with such unqualifiedly good results in respect to light and definition, as have not been obtained by similar contrivances heretofore.

MICROSCOPY. — Mr. F. Kitton, an accomplished contributor to *Science Gossip*, objects strenuously to the terms microscopy and microscopist. He argues that there is no such science as microscopy, because its objects of study belong to zoölogy, botany, etc. Precisely the same statement might be made in regard to anatomy, physiology, and to histology, which he mentions in the same sentence without protest. All of these terms are too convenient to die, and the "microscopy" of *Science Gossip* itself is too good to be suppressed or dispersed by suicidal theories in regard to its name. Even as a word, microscopist is no worse than pianist or organist, and microscopy is as good as thermometry.

SCIENTIFIC NEWS.

— *Nature* for June 1st contains a brief biography, with a steel portrait, of Professor Wyville Thompson, the leader of the Challenger Expedition, which returned to England May 27th, after a voyage around the world of about three years and a half. The expedition, says *Nature*, although by no means sensational, has been thoroughly successful. The Challenger has steadily traversed a track of sixty-nine thousand miles and during her absence of three years and a half from England has established three hundred and sixty-two observing stations, at all of which the depth has been ascertained with the greatest possible accuracy, and at nearly all the bottom temperature has been taken, a sample of the bottom water has been brought up for physical examination and chemical analysis, a sufficient specimen of the bottom has been procured, and the trawl or dredge has been lowered to ascertain the nature of the fauna. At most of these stations serial soundings have been taken with specially devised instruments, to ascertain, by the determinations of intermediate temperatures and by the analysis and physical examination of samples of water from intermediate depths, the directions and rate of movement of deep-sea currents. The only untoward event was the death of Dr. Willemöes-Suhm, one of the naturalists of the expedition. An illustrated account of the voyage in two volumes is nearly ready for publication, and promises to be of unusual interest.

— Dr. Elliott Coues, U. S. A., lately attached to the Northern Boundary Survey, has lately been ordered on duty with Professor Hayden's Geological Survey of the Territories, his address being the office of the U. S. Geological Survey of the Territories, 509 Seventh Street, Washington, D. C. It is a matter of congratulation that Dr. Coues's time will as heretofore be devoted to zoölogical pursuits.

— E. Billings, for many years the able palæontologist of the Canadian Geological Survey, has recently died.

— Rambles of a Naturalist in Egypt and other Countries, by J. H. Gurney, Jr., is announced by Jarrold and Sons, London.

— A botanical section of the Boston Society of Natural History has been formed, which meets during the summer every Monday at four P. M.

— The first wing of the Peabody Museum of Natural History of Yale College is now completed, and part of the collections have been placed within it. This wing is situated on the southwest corner of Elm and High streets. It is built of brick, with ornaments of light Nova Scotia sandstone. The cost of the building was about $140,000, and the cases will increase the expense to $175,000. The museum is much the largest structure yet erected for the college. The exterior is of Philadelphia pressed brick and Nova Scotia stone, with a podium or base of East Haven brown stone. The architecture of the lower stories is especially massive, the structure increasing in lightness as it rises. The construction is fire-proof throughout. There is an immense elevator, capable of taking up the largest fossils, which rises one hundred feet.

— The twenty-fifth meeting of the American Association for the Advancement of Science will be held at Buffalo, N. Y., beginning at ten o'clock A. M., on Wednesday, August 23d.

The address of Mr. F. W. Putnam, the Permanent Secretary, will be Salem, Mass., until *Saturday morning, August 19th;* after that time, and until the meeting has adjourned, Buffalo, N. Y.

The officers of the Buffalo meeting are the following: President, William B. Rogers, of Boston; Vice President, Section A, Charles A. Young, of Hanover; Vice President, Section B, Edward S. Morse, of Salem; Chairman of Permanent Subsection of Chemistry, G. F. Barker, of Philadelphia; Chairman of Permanent Subsection of Anthropology, L. H. Morgan, of Rochester; Permanent Secretary, F. W. Putnam, of Salem; General Secretary, T. C. Mendenhall, of Columbus; Secretary of Section A, Arthur W. Wright, of New Haven; Secretary of Section B, Albert H. Tuttle, of Columbus; Treasurer, Thomas T. Bouvé, of Boston.

The attention of chemists is specially directed to the fact that the Chemical Subsection, formed at the Hartford meeting, has been made a permanent organization. The attention of entomologists is directed to the action taken by the entomologists at the last two meetings, and to the annual meeting of the Entomological Club of the Association which will be held at Buffalo, on Tuesday, August 22d (the day preceding the meeting of the Association), at which all interested are invited to be present.

A Permanent Subsection of Anthropology was organized at Detroit, and a committee was appointed for the purpose of developing the subsection at the Buffalo meeting. Members interested in this department are specially requested to make known the formation of the subsection. A circular issued by the special committee will be sent by the Permanent Secretary on request. It is expected that special arrangements will be made for the Subsection to attend the Archæological Convention to be held in Philadelphia, on September 4th.

It was suggested at the last meeting that special efforts be made to bring the microscopists together at Buffalo in order to form a permanent organization, either as a subsection or as a club on the plan of the Entomological Club. From the interest already evinced by a number of leading microscopists definite action will, undoubtedly, be taken on the subject at the coming meeting. For special information on this subject, microscopists may address Dr. R. H. Ward, 53 Fourth St., Troy, N. Y.

— It is proposed to hold an International Convention of Archæologists, at Philadelphia during the Centennial, and in connection with the Centennial Exhibition, for the purpose of promoting acquaintance and increasing the means of information in American Archæology and Ethnology. The "State Archæological Society of Ohio" will provide rooms for the Convention, and the first meeting will be held in the Ohio Building, at two o'clock, P. M., September 4, 1876. Those proposing to attend are requested to notify the Chairman of the Ohio Committee, Rev. S. D. Peet, Ashtabula, Ohio. At the meeting of the American Association for the Advancement of Science, at Buffalo, N. Y., August 23d, a Subsection of Anthropology will be formed. The Convention has been appointed near the close of the sessions of the "Association" in order that those who desire may conveniently attend both meetings.

— Messrs Longmans, Green, & Co., have recently published An Introduction to Animal Morphology and Systematic Zoölogy. Part I. Invertebrata. By Prof. Alexander Macalister. Macmillan & Co. have published The Geographical Distribution of Animals, by Alfred R. Wallace. 2 volumes, 8vo.

— The Third Bulletin (vol. ii.) of the United States Geological and Geographical Survey of the Territories has the following table of contents: Notes descriptive of some Geological Sections of the Country, about the Head-Waters of the Missouri and Yellowstone Rivers, by F. V. Hayden; Notes on the Tertiary and Cretaceous Periods of Kansas, by B. F. Mudge; Notes concerning a Contour Map of the United States, by Henry Gannett; The Flora of Southwestern Colorado, by T. S. Brandegee; Brief Synopsis of North American Earwigs, with an Appendix on the Fossil Species, List of the Orthoptera collected by Dr. A. S. Packard in Colorado and the Neighboring Territories during the Summer of 1875; Notice of a Small Collection of Butterflies made by Dr. A. S. Packard in Colorado and Utah in 1875, by S. H. Scudder; Notes on the Grammatical Structure of the Nez Percés Language, by George Ainslie.

— The Appalachian Club of Boston issued the first number of its journal under the title of *Appalachia*, about the middle of July. It contains a sketch map of the White Mountains, profile of Trapyramid, with other papers, and the proceedings of the club.

— Dr. Kidder's contributions to the Natural History of Kerguelen Island, made in connection with the United States Transit-of-Venus Expedition, in 1874–75, contains articles on the eggs of birds, by Drs. J. H. Kidder and E. Coues; on the botany, by Dr. Asa Gray; geology, by Drs. F. M. Endlich and Kidder; on the mollusks, by W. H. Dall; the insects, by Baron R. Ostensacken and Dr. H. A. Hagen; the crustaceans, by Prof. S. I. Smith; the annelids and echinoderms, by Prof. A. E. Verrill. The number concludes with a study of *Chionis minor*, with reference to its structure and systematic position, by J. H. Kidder and Elliott Coues.

— We have received a folio pamphlet of twenty-four pages, on the invertebrate animals of Travemünder Bay, by H. Lenz, being appendix

I to the Annual Report for 1874–75 of the Commission for the Scientific Investigation of the German Sea at Kiel. These reports are of much scientific and practical value, and it would be very desirable if the United States Government could have similar work done in connection with the Coast Survey.

— Mr. Julius Stoerzer, of the National Museum at Washington, died on the 13th of May, aged thirty-four years, leaving a wife and child. Mr. Stoerzer, at the time of his death, was unquestionably the most thoroughly trained and really scientific taxidermist in the country. A pupil of the celebrated Martin, a good comparative anatomist, an enthusiast in his profession; his very skeleton frames of boards and hoop-iron had more life and action in them than the completed inflations we are generally asked to call stuffed animals. The magnificent group of fur seals, now at the Centennial Exhibition, is one of his masterpieces, and is unequaled in any part of the world so far as those animals are concerned. Mr. Stoerzer's death is regretted by all who knew him, and it is felt that with him an artist as well as a preparator has passed away, who can hardly be replaced.

PROCEEDINGS OF SOCIETIES.

Philosophical Society of Washington. — April 22. Major J. W. Powell read a paper on monoclinal folds in orographic geology, tending to show that the higher the strata were elevated above the general surface, the greater the proportional rapidity of their denudation or erosion. He also showed how by unequal elevation on two sides of a fault and general erosion, beds of unequal age might be brought into such close proximity as to lead to errors in identification. This was illustrated by the case of the Green River beds, referred by Cope, Lesquereux, and Hayden to different horizons as a whole, from specimens gathered from apparently identical strata within a few hundred yards of each other. While each investigator had rightly referred the organic remains submitted to his examination to their proper horizon, the error, according to the speaker, had arisen from supposing that the adjoining and apparently identical beds were really continuous; when, actually, faulting had taken place on three cross lines of fracture, with differing elevation and uniform erosion, thus bringing into almost exact parallelism, beds of different age.

A discussion followed in which the question of the thickness of the earth's crust was debated. Mr. Taylor, Major Powell and others, finding it difficult to reconcile the multifarious changes of level of small areas with a crust of great thickness, while Captain Dutton regarded a solid nucleus with a hydrothermal plastic layer between it and the outer crust as meeting the requirements of the case.

Cambridge Entomological Club. — March 10. Mr. Burgess described some appearances in the pupæ of *Eudamus Tityrus*, by which he thought it might be possible to know the sex of the pupæ.

Mr. Mann described some great variations in the appearance of larvæ which afterwards produced female imagos of *Anisopteryx pometaria.*

Mr. Scudder referred to the presence of *Gryllus domesticus* in several parts of the country, into which it had been introduced from various parts of Europe. He had not succeeded in an attempt to naturalize the species in Cambridge, the specimens which he had, that had come to Boston from some undetermined source, in an East India merchant-vessel, having been destroyed by accident.

Upon the table lay an Entomologists' Bulletin in manuscript, which had been prepared by Mr. Mann, and contained the addresses of about three hundred North American entomologists, with a notice of the special pursuits of each, when known, and such other information of a similar kind as would be of interest to entomologists. This Bulletin was open to the inspection of all who wished to see it, and all were requested to communicate to Mr. Mann such information as would enlarge and freshen this record.

April 14, 1876. Dr. Hagen gave a very interesting account of the mode of gathering, and of some of the properties of amber.

Mr. Scudder exhibited specimens of *Cyaniris lucia*, *C. violacea*, *C. neglecta*, and *C. pseudargiolus* to illustrate a paper which he read, showing that these so-called species are probably only forms of one species, which must retain the name of *Cyaniris pseudargiolus.*

Dr. Hagen gave some information about an insect allied to *Mantispa* (but possessing an ovipositor), which he had lately received from Lieutenant Wheeler's Expedition, as having been caught at Fort Tejon, Southern California. This is the more interesting, as no Hemerobina, except its congeners and the species of the genus *Dila*, possess an ovipositor. The insect lives in wasps' nests.

Mr. Scudder said that in working up the Forficularians of North America, he had detected thirty-eight species; there are undoubtedly many more, especially in Mexico. Only fourteen species are found in the United States and only nine of these are indigenous. Mr. Scudder has prepared a synoptical table of the United States species for publication in *Psyche.*

Mr. Austin said that on the 26th of March he obtained at least twenty-eight species of Dytiscidæ in a small clay pit which had become filled with water. Some of the species occurred in immense numbers. Dr. Hagen suggested that the absence of fishes would account for the great abundance of these beetles.

ACADEMY OF SCIENCES, St. Louis. — May 1. Mr. Riley made a communication on the oviposition of *Leucania unipuncta*, or the Army-Worm Moth.

In his eighth Annual Report, the last forms of which were going through the press, he had remarked that "at first view it seems singular that the eggs of an insect that appears in such countless myriads from Maine to Georgia, and from Virginia to Kansas, should have remained undiscovered either by farmers or entomologists. One of the obstacles that have stood in the way is, that, as soon as the worms have increased so prodigiously as to attract attention, their natural enemies become so multiplied that a very small per cent. of the worms entering the ground issue again as moths. A second reason is that during the season when the insect is not numerous, and attracts no attention, no one thinks of searching for the eggs. A third reason is that the moths that are reared indoors do not oviposit in confinement. I venture to suggest a fourth possible reason that has hitherto occurred to nobody: it is that the eggs are for the most part secreted where they are not easily seen."

Structure is a trustworthy guide to habit, and Mr. Riley had been led to this last conclusion by a study of the structure of the ovipositor of the moth in question. The time, place, and manner of oviposition in this species is quite important from the economic point of view, as the insect may readily be destroyed in the egg state by fire, if the conclusions drawn were correct.

Mr. Riley had recently been able to verify the correctness of his conclusions by direct observation, having witnessed the mode of oviposition on blue grass. The eggs are, as he surmised, secreted, being either glued in rows of from five to twenty in the groove which is formed by the folding of the terminal grass-blade, or in between the sheath and the stalk. More rarely they are pushed into crevices in the ground, especially at the base of the grass-stalk. The eggs are white, slightly iridescent, spherical, and only $\frac{3}{100}$ of an inch in diameter. They are fastened to each other and to the leaf, and covered along the exposed portion by a white, glistening, viscid substance. As they mature the color becomes more sordid or yellowish, and by the seventh day after deposition the brown head of the embryon shows distinctly through the shell. The larva hatches from the eighth to the tenth day, measures 1.7 mm. in length, is dull, translucent-white in color, with a large brown-black head, and is a looper, the two front pair of abdominal prolegs being atrophied. On account of its extremely small size and of the color resembling the pale bases of the grass-stalks near the ground, it is almost impossible to find them even where there are dozens to the square foot.

ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA. — March 21. Dr. Leidy called attention to a fragment of the lower jaw of a mastodon found on the Amazon by Dr. Isaac S. Coates, of Chester. The species was determined to be *Mastodon andium.*

Mr. Meehan spoke of the phenomenon of natural inarching among trees. He described and explained such an occurrence in the case of a hemlock growing in the neighborhood of Germantown.

Professor Cope placed on record a new type of insectivorous mammals. It is allied to the extinct rodent-like forms from the Bridger beds, which are characterized by a prolonged growth of the incisors, having enamel only on one side. The incisors in the form under consideration have enamel on the front and back, but not on the side. The characters of the other teeth were given as they exist in the genera Calamodon and Ectogamus, in each of which two species are known. The relationship established by these genera between the Edentata and the other mammalia was alluded to. These forms are both from the Wasatch beds of New Mexico. The name Tæniodonta was proposed for the group indicated.

Dr. Koenig called attention to a mineral, probably tantolite, from North Carolina. The distinction between columbite and tantolite is difficult to determine. The peculiarities discovered by analysis were described at length and the distinctive characters indicated. Its specific gravity is 5.8.

April 4th. Prof. Burt G. Wilder, of Cornell University, made a communication upon the anatomy and development of the brain in fish-like vertebrates. After considering the taxonomic value of the brain, he spoke of the investigations of Huxley, Owen, and the continental naturalists, dwelling particularly upon the causes of the great inaccuracy in the figures of fishes' brains contained in the text-books. He had endeavored to ascertain how far the brains of fishes might be homologized with the typical brain described and figured in diagram by Huxley. The differentiation of the three typical cerebral vesicles was described, and the fact stated that while the typical description applies to all the higher vertebrate brains, neither the lateral ventricles nor the foramen of Munroe had been observed in the brains of fishes until recently found by Professor Wilder in the gar-pike. He had since found them in the lamprey and the hag-fish, in several sharks and skates, in sturgeons, in the spoon-bill sturgeon, in the mud-fish or Amia, and in several typical bony fishes. He showed in what way the nearly solid front mass of the adult shark's brain is formed from a thin-walled vesicle in the embryo. The structure of the brain in ganoids and teleosts was described, and the distinction indicated that in the latter, although the lateral ventricles and the foramen of Munroe are present, they are so small as to be almost invisible. We are forced back, therefore, in searching for the distinctive character of the ganoid brain, upon the chiasma of the optic nerves of Müller. In considering the taxonomic value of these characters, the belief was expressed that the structure of brains will be found to be less dependent upon external modifying circumstances than are other parts of the animal organization.

In conclusion, Professor Wilder exhibited and described the brain of Chimæra, and indicated its relations to the other groups spoken of. He regarded the brain as presenting characters intermediate between the sharks and skates, the ganoids and the batrachians with Lepidosteus.

Professor Cope called attention to the entire novelty of certain of the observations made by Professor Wilder, and suggested the direction of further investigation of the subject, expressing the belief that the chiasma of the optic nerves would yet be found in the lowest of the typical bony fishes.

Professor Koenig placed on record an analysis of garnet from Yancey County, North Carolina. Mr. Roberts announced the finding of uranite at Wayne Station, Germantown.

Mr. Mather, Superintendent of the Centennial Aquaria, submitted for the inspection of the members living specimens of the grayling and a species of Campostoma, upon which explanatory remarks were made by Professor Cope.

Mr. Mather called attention to a fungus growing upon the Campostoma, which, he stated, would sooner or later prove fatal. Dr. Leidy explained that the growth mentioned was the *Achyla prolifera* of botanists, and described its development. Dr. Koenig suggested the application of salicylic acid for the destruction of the fungous growth. The president and Professor Frazer further spoke of the properties of salicylic acid.

Mr. A. H. Smith and Mr. Thaddeus Norris described the habits of a species of game fish inhabiting the Saginaw River.

ACADEMY OF SCIENCE, St. Louis. — April 3d. Professor Potter, Chairman of the Committee on Mound Exploration, made a partial report, as follows: The committee have examined and made a survey of five groups of mounds. Two hundred specimens of pottery have been obtained, of which one hundred and twenty-six are quite perfect, the remaining specimens being in a fair condition, and may be wholly or in part restored. The collection also embraces the skulls of twenty individuals, of which number one is complete, seven nearly so, the remaining twelve being in fragments of sufficient size to be of value. They have also obtained the leg and arm bones, and in some cases the vertebræ and other small bones, representing twelve individuals.

Mr. Theo. P. Gillespie, a gentleman recently arrived from Peru, was introduced to the members by Dr. Briggs, and exhibited a beautiful collection of pottery taken from the burial grounds of an ancient tribe of Peruvians. The graves from which the specimens were taken were in very dry drift sand near the sea-beach. The graves are supposed to belong to a tribe that was conquered by the Incas fifty or sixty years before the advent of Pizarro in Peru. Many bones were found, being preserved by the perfect dryness of the sand in which they were buried. The greater portion of these relics were found along the line of the Chimbote and Huaraz Railroad, latitude 7° S., and with few exceptions they represent what are supposed to have been drinking-vessels. In several of the specimens the handle, which is hollow, arches over the top of the vessel, the two branches of the tube uniting in a single vertical tube of several inches in length. The ornamentation, both in form and color, was in many cases very striking and expressive. A small mold of strongly-baked clay, — the negative of a human face, — containing within it the figure which it was designed to reproduce, was shown. The collection contains twenty-seven specimens. Three specimens of copper were also exhibited, namely, a finger-ring, a long needle with an eye, and a chisel with a smooth edge and battered head.

THE APPALACHIAN MOUNTAIN CLUB, Boston. — April 12th. Mr. S. H. Scudder read a paper on The Correct Name of the Mountain called Pequawket or Kiarsarge, which was followed by considerable discussion, in which Mr. Emery, of Exeter, N. H., quoted from a journal of Samuel Willard, an old scout, written in 1725, to prove that the country round about was formerly called Pequawket, and that should be the proper name of the mountain. Mr. George Fox argued that while this was a name of the territory, it should not be applied to the mountain at all. Mr. J. B. Henck, Jr., who has made a partial map of the mountain region, read a paper on The Construction of a New Map of the White Mountains. Mr. Warren Upham read a paper on The East Branch of the Pemigewassett, which he had visited the past summer; and Prof. E. C. Pickering made a communication on Professor Bond's Manuscripts relating to the White Mountains.

The first field meeting of the club will be held at North Conway, N. H., on the fourth Wednesday in July.

SCIENTIFIC SERIALS.[1]

ARCHIV FÜR MIKROSKOPISCHE ANATOMIE. — On the Pulsating Ventral Sinus of Insects, by V. Graber. Comparative Developmental History of *Comatula mediterraniensis*, by Alex. Goette.

PETERMANN'S GEOGRAPHISCHER MITTHEILUNGEN. — March 21st. Cernik's Expedition through the Region of the Euphrates and Tigris. April 5th. Cameron's Journey across Africa, by E. Behm. Journey in New Zealand. Swedish, Russian, and Dutch Journeys to West Siberia.

ANNALS AND MAGAZINE OF NATURAL HISTORY. — June. Notes on Otto Hahn's Micro-Geological Investigation of *Eozoön Canadense*, by W. B. Carpenter. On the Identity in Type of the Annelids and Vertebrates, by C. Semper.

AMERICAN JOURNAL OF SCIENCE AND ARTS. — June. The Geological Survey of Brazil, by C. F. Hartt. On a New Sub-Order of Pterosauria, by O. C. Marsh. Notice of New Odontornithes, by O. C. Marsh. — July. The Colorado Plateau Province as a Field for Geological Study, by G. K. Gilbert. On a Disease of Olive and Orange Trees occurring in California in the Spring and Summer of 1875, by W. G. Farlow.

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[1] The articles enumerated under this [illegible] will be for the most part selected.

THE

AMERICAN NATURALIST.

VOL. X. — SEPTEMBER, 1876. — NO. 9.

ARE WE DRYING UP?

BY PROF. J. D. WHITNEY.

THE object of the present communication is to bring together some of the more striking facts in regard to the desiccation of the earth's surface, — or at least of a considerable portion of it, — which has taken place in the most recent geological period, and to suggest the inquiry, whether we have any proof that this desiccation has been and is continued into the historical period; in short, Are we drying up?

All questions relating to changes, or supposed changes, of climate during the historical period are of the greatest possible interest. Much has been written on this subject, and yet but little has been definitely established. There is a prevailing popular impression that the countries around the Mediterranean are drier than they were two or three thousand years ago, and that this change is due in part, if not wholly, to the cutting down of the forests which are assumed to have once existed there. Yet, when this matter comes to be investigated, it would appear that there is little if any evidence either that there has been any such wholesale stripping of the wooded lands, or that there has been any considerable change in the climate of that region. The question of the influences of forests on the amount of the rainfall has been ably and carefully examined by Mr. G. P. Marsh, and his results are thus summed up: "The scientific reputation of many writers who have maintained that precipitation has been diminished in particular localities by the destruction of the forests or augmented by planting them, has led the public to suppose that these assertions rested on sufficient proof. We cannot affirm that in none of these cases did such proof exist, but I am not aware that it has ever been produced."[1] It ap-

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[1] The Earth as Modified by Human Action. New York, 1874. Page 196.

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pears to be true, at all events, that exact observations with the rain-gauge have not yet anywhere been kept up for a sufficient time to enable us to speak with certainty with regard to the existence of any secular change in the amount of rain falling at any one place. The length of time during which such observations have been made is but trifling compared with the duration of the historical period, and infinitesimally small when considered with reference to even the most recent of the geological epochs.

We have, however, as will be seen, abundant evidence of a great change over at least a considerable part of the earth's surface, in the amount of water distributed in the lakes or running in the rivers, and it can be shown, beyond a doubt, that this change has been taking place within a very recent period, speaking geologically. Some important evidence can also be adduced to the effect that this change has been continued in the historical epoch, although not yet capable of demonstration by the recorded observations of the rain-gauge.

There are two regions especially where the facts already collected show most clearly, not only a diminution in the amount of water existing on the surface, but a most striking one. In Central Asia and in Western North America, the observations of numerous observers all point unmistakably in this direction. The observations of the Schlagintweits in Thibet and Turkistan may first be mentioned. One or two extracts may be given from H. von Schlagintweit's article entitled, "Investigations on the Salt Lakes in Western Thibet and Turkistan."[1] He writes as follows: "In all portions of High Asia, south and north of the main water-shed, there are numerous places where the former existence of mountain lakes may be recognized." . . . "In Thibet, throughout the entire longitudinal depression between the chain of the Himalaya and the main water-shed of the Karakorum, of the once numerous lakes, but comparatively few are still in existence." . . . "So extreme is the dryness in Western Thibet that, in the case of nearly all the lakes still remaining, the evaporation exceeds the supply of water, so that the prevailing condition is at the present time one of gradual diminution in the area covered by water." There seems to be here, in combining all the results of the Messrs. Schlagintweits' observations, abundant evidence of a marked change of climate in the most recent geological period, — resulting in the almost entire disappearance of extensive lakes, — and also that this desiccation is still going on.

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[1] From the Proceedings of the Bavarian Academy of Sciences, Cl. II. Band xi. Abth. 1.

The observations of Mr. Drew, the author of an elaborate work on the Jummoo and Kashmir territories,[1] fully corroborates the often previously expressed opinion, that the Valley of Kashmir was, in later geological times, completely occupied by a lake. But no evidence has, as yet, been discovered to prove that this desiccation took place during the historical period, although the traditions of the natives point in that direction. There is, however, abundant proof of diminution in the area covered by water in the basin of the Aral and Caspian seas, not only during the latest geological epoch, but also within a comparatively recent period. Those who wish to investigate the matter will find the material in a paper by Major Wood, published in the journal of the Royal Geographical Society for 1875. There is no doubt of the former vastly greater extension of the Caspian and Aral seas. While there has been much discussion with regard to the shifting of the channels of the rivers entering these seas, and their variations of height at various times during the historic period, it seems beyond dispute that a gradual desiccation of the region has been in progress, and that it is still going on. That there once existed here a vast Asiatic Mediterranean which connected by navigable waters with the Northern Ocean is very generally admitted. With reference to the diminution in the water of Lake Aral at present going on, Major Wood says:[2] "The sand-drives and tracts of hard clay occurring on the low shores of Lake Aral point to the conclusion that extensive areas of country which are now dry land were formerly covered by the water-spread of the lake. It has been remarked that the mouth of the Syr-Daria has become in recent years fordable, and that the depth of water between the island of Tokmak Atta and the south shore of Lake Aral has diminished. It is also an established fact that a minaret, which gray-beards of the Kirghiz state was formerly situated on the edge of the eastern shore, is now at some hours' walk distant from it; and finally, since 1848, when it was a marshy swamp, Gulf Abougir, at the southwest corner of the Lake, has been entirely dried up, and its bed is now under cultivation. There is no doubt that the cause of this continuous shrinking in the area of Lake Aral is that the evaporation from its surface is in excess of the supply received by it from the Amu and from the Syr."

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[1] The Jummoo and Kashmir Territories. A Geographical Account. By Frederic Drew, F. R. G. S., F. G. S., London. 1875.

[2] Journal of the Royal Geographical Society, vol. xlv. page 403.

Similar facts in regard to the diminished quantity of water in Arabia are cited by various travelers in that country. Some of them are given in Mr. Marsh's volume, to which reference has already been made.

In Africa the existence of extensive ruins in the Great Libyan Desert, in a region quite destitute of water, and which is now entirely uninhabited, may be taken as a strong indication of great changes since the historic period. Dr. Livingstone, in his travels in southern Central Africa, was again and again much impressed with the proofs presented to him of a rapid and extensive diminution within recent times of the amount of water in the lakes and rivers of that region.[1]

But it is not only in the Old World but also within our own territory that a former much greater extension of the water system can be easily demonstrated. The terraced character of the rivers of our northeastern States afford ample proof that these once conveyed a much larger quantity of water than they now do. The facts have been set forth in detail by various geological writers, and especially in President Hitchcock's Surface Geology. It is true that geologists have only lately generally admitted the apparently self-evident fact that the origin of these terraces is due to a diminution in the quantity of water which the streams have conveyed, and not to any sinking or rising of the land.

It is, however, in the region west of the Rocky Mountains, especially in the "Great Basin," that we find a condition of things most strikingly resembling that already noticed as existing in Central Asia. Everywhere, throughout the area occupied by Utah and Nevada and portions at least of the adjacent territories, the evidences of desiccation within the most recent geological period are very striking. These facts were first brought to notice in part in the Geology of California, volume i. (1865), in which the terraces surrounding Mono Lake were described, and the former greater extension of this and the adjacent lakes shown to be beyond doubt. The same thing was also noticed and commented on in the Yosemite Book (1869). The terraces surrounding Great Salt Lake are so conspicuous that no traveler passing through that region on the railroad could fail to notice them. The publication of the detailed maps of this region by the Fortieth Parallel Survey will, no doubt, furnish data for estimating with considerable precision how large an area was formerly covered with water, and how numerous and extensive the different bodies of water were.

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[1] See Livingstone's Missionary Travels in South Africa. London. 1857. Page 528. He says: "All the African lakes hitherto discovered are shallow in consequence of their being the mere *residua* of very much larger ancient bodies of water."

It is not to be expected that in our western territories there should be any proof obtained of a diminution in the quantity of water having taken place during the historic period. The character of the aboriginal inhabitants and the perishable character of their dwellings forbid this. Yet there are traditions pointing in this direction, as noticed in the Geology of California, volume i., the mountaineers insisting on the former connection of Mono and Walker's Lakes. However this may be, it is certain that the sharp and well-defined character of the terraces in this region indicates very clearly that the diminution of the volume of the water must have been an extremely recent phenomenon.

It is not possible at this time to enter upon a discussion of the question of the connection of this desiccation with the so-called glacial phenomena. It has seemed natural, of course, for geologists to connect the terraced condition of the rivers in the northeastern States with the melting of the ice of the glacial period. As far as the problem at present under discussion is concerned, it makes no difference whether we do or do not consider the desiccation in question as one of the sequence of events to which the glaciation of a portion of the northern hemisphere belongs. What we are specially interested in is, whether the desiccation is still going on. If, as seems highly probable from what has been advanced in the previous pages, the quantity of water on the surface, over large areas, has considerably diminished, certainly in the very latest geological times, and also in part within the historic period, then it is not likely that the former glaciation and the present desiccation can be considered as so intimately connected in their general cause that the latter cannot take place except as a sequence of the former. The absence of any very distinct proof of a much greater extension at any time of the ice masses over the ranges of Central Asia must be taken into consideration in connection with the extensive and rapid drying up of what has been and is now going on in that region. The same may be said in reference to the Great Basin and our own western territory. At the time of the greatest extension of the glacial masses in that region, but an insignificant proportion of the surface was thus covered. Only the very summits of the highest ranges had glaciers upon them, and the amount of snow and ice thus stored away would seem to have been far too small to produce by their melting a general filling of all the valleys with water unless we assume — which is certainly not probable — that the change was almost instantaneous.

It is certain that both in Asia and North America the phenomena of desiccation are on too grand a scale by far to be supposed to have anything to do with cutting down of forests. The drying up has been commenced before man interfered with nature, and has been continued without reference to his puny operations.

If, as has been suggested, the records of rain-gauge and thermometer are too incomplete and unsatisfactory to throw any light on the question of climatic changes of importance in modern times, the question arises whether there are not other sources of information to which recourse can be had. For instance, records have, in parts of Europe, been kept for many years of the flow of water in some of the principal rivers. Can any results be obtained from a comparison of these records with a view to the settlement of the question, whether the amount of water passing from year to year at certain points has diminished, increased, or remained constant? The eminent geographer, Berghaus, was one of the first to take up this investigation. He worked up the observations of the Rhine made at Emmerich, those of the Elbe at Magdeburg, and those of the Oder at Küstrin, and came to the conclusion that each of these rivers had decreased in volume during the past hundred years, and that there was reason to fear that they would eventually have to disappear from the list of the navigable streams of Germany. Later than this, an eminent hydraulic engineer, Gustav Wex, chief director of the important "Donauregulirung,"[1] and a high government official, undertook the same investigation, but with much more detail. His results, however, are similar in character to those of Berghaus, and seem to demonstrate beyond the possibility of doubt that the principal streams of Middle Europe, namely, the Danube, the Rhine, the Elbe, the Vistula, and the Oder, together draining an area of 570,000 square miles, have for many years been carrying a constantly diminishing quantity of water. The longest series of observations used in coming to this conclusion is that of the Elbe, at Magdeburg, where the records go back for one hundred and forty-two years; but the observations for shorter periods of from fifty to seventy years, which in the case of the other streams are all that are available, seem to leave no doubt as to the character of the result.

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[1] A great work undertaken with a view to the regulation and improvement of the channel of the Danube at and near Vienna.

The probable causes of this diminution in the quantity of water in the Middle European streams are discussed at some length by Mr. Wex,[1] as also by a committee of the Vienna Academy of Sciences, appointed to report on his communication, and among whom were several eminent meteorologists. The general impression, both of Mr. Wex and the committee, seems to be that the cutting down of the forests is the essential cause of the desiccation. But the number of facts which can be given in support of this hypothesis is quite small. It is, as Mr. Marsh has stated, not so much facts as the general opinion on which reliance is placed in citing the destruction of the forests as the probable principal cause of the difficulty. It is easy to see that stripping the woods from the surface increases the rapidity of the evaporation, and that in consequence of this less water must flow in the streams unless the deficiency is made up by a larger precipitation. It is extremely difficult to prove anything in this connection in a region where so many small patches of forest are mixed up with the cleared land, as is the case in Germany. But it is fair to presume that the moisture taken up in one part of a great river basin must be let fall again in the form of rain somewhere within the limits of the same basin. Hence we should have no difficulty in understanding that stripping the surface of its trees would cause increased and irregular precipitation, which would have injurious and even disastrous effects in mountain regions, where the soil was thus laid bare to be washed away by torrential flows of the streams following on sudden and heavy falls of rain. That this is really the case is well known from experience in the Swiss and French Alps, and elsewhere. But that a positive diminution in the average quantity of water carried down in the streams would necessarily ensue on removing a portion of the forests in any region, we do not consider to have been proved as yet. The commission, in reporting on Mr. Wex's paper, are quite cautious in their expressions of opinion on this subject, showing their uncertainty by even taking into consideration the question whether the progressive hydratation of mineral substances consequent on the cooling down of the crust of the earth, may not. as suggested first by Saemann and afterwards by Delesse, have something to do with the proven desiccation.

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[1] This paper was published in the Zeitschrift des öst. Ingenieur and Architekten Vereins for 1873.

In regard to one question this commission of the Vienna Academy is quite unanimous, and this is that great pains should be taken by the different governments of the enlightened states throughout the world to obtain more light and additional data bearing on this subject. If desirable for Europe it is still more so in this country. We need much more numerous and more accurate observations of rain-fall. One cannot but be struck, in examining Mr. Schott's working over of the Smithsonian rain-tables, with the poverty and incompleteness of the data. We need also careful and long-continued measurements of the amount of water flowing in some of our principal rivers. For instance, New York should establish a systematic investigation of the Hudson River, and Massachusetts or Connecticut, or both, should take in hand the river which flows through those two States, and which is of so much importance to their manufacturing and other interests. For California, especially, these investigations are of the greatest importance. If it can be shown that the removal of the forests seriously diminishes the quantity of water running in the streams, then there is yet time to stay the hand of the wood-cutter ere the mischief be consummated. That the stripping of the Sierra Nevada of its timber would be essentially injurious to the State in increasing the already alarming irregularity of the seasons there can be little doubt, even if the average precipitation were to remain the same.

That there has been a very marked decrease in the amount of water on the earth within the most recent geological period is beyond a doubt; and that there is considerable reason to believe that the desiccation is still going on has, we think, been made evident in the above pages, although it has been necessary to handle with extreme brevity the various points advanced. Much might be said with reference to the connection of the so-called "glacial epoch" with the present one of desiccation, but this part of the discussion must be reserved for another occasion.

THE MODE IN WHICH COCKROACHES AND EARWIGS FOLD THEIR WINGS.

BY SAMUEL H. SCUDDER.

SEVERAL years ago, Dr. Henri de Saussure, of Geneva, published, under the title of Études sur l'Aile des Orthopteres,[1] some interesting observations on the structure of the wings of cockroaches. He treated particularly of the folding of the wings in those groups of Blattarians where the wing is very ample and some contrivance necessary to insure its complete protection by the smaller wing-covers. The necessity of some peculiar arrangement in the winged genera of earwigs, where the extended wing is often ten times larger than the wing-covers (tegmina) is even more evident; and to understand the nature of the structural modifications of a normal wing-type (which are here universal), it will be convenient and instructive to examine the cockroach's wing on the basis of Saussure's memoir, for in different genera of this group we have every stage of change from simple unreversed wings scarcely larger than the tegmina, to those of great size, curious complication, and unique mode of duplicature.

In the hind wings of all Orthoptera, the anal area, or the area traversed by the nervules of the posterior part of the wing, is unusually ample; the branches of the anal vein are numerous and straight, and originate not far apart nor far from the base of the wing; when the wing is fully expanded they diverge like the rays of a fan; and like a fan they fold themselves against the sides of the body, the membrane of the wing folding along an edge midway between each pair of rays; this admits of a large expansion of the anal field, and provided the wings are not quite so long as the tegmina, any breadth, folded close, may be covered by this coriaceous appendage. This, however, would not necessarily be true, if the anterior part of the wing, provided with stiff interlacing veins, were itself as broad as the tegmina; for then, if the front edges of the wings and tegmina were brought together, the entire folded anal area would extend beyond the opposite margin of the wing, quite unprotected by the tegmina; to obviate this, the line of separation between the anal area and the anterior part ot the wing is itself an axis of duplicature, and the folded anal area always lies beneath the stiff anterior parts of the wing.

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[1] Annales Sc. Nat. [5] Zool. x. 161–200, plate 11.

This is a mode of duplicature common to all groups of Orthoptera. But we have in cockroaches and earwigs something superadded, where the wing is large, and folded not only longitudinally but transversely, and is ingeniously packed away beneath the shorter tegmina. We will follow Saussure in tracing among the cockroaches the various steps from the simple to the complex form.

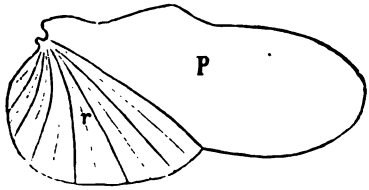

Fig. 29.

As usual among insects, the anal field of the hind wing in cockroaches (Figure 29, *r* [1]) does not generally extend much more than half way toward the tip of the wing; and, as in most insects, especially those of low organization, the upper limit of this area (that separating it from the principal part of the wing, Figure 29, *p*) is marked at the edge of the wing by a slight emargination. The first step toward the result to be attained is the lengthening of the anal field so that it equals the anterior parts, bringing the indentation to the apex of the wing. This is seen in *Thorax porcellana* of the East Indies. There is, however, a little triangular bit of membrane left between this indentation and the lowermost nervule of the next vein above. It is to this little triangle that we must direct our attention. For in the next stage, such as is seen in a common European cockroach, *Ectobia lapponica*, this triangle has greatly enlarged; the principal longitudinal fold of the wing, that separating the anal area from the parts above, is obliged to run directly through the middle of this triangle, so that we may fairly consider one half as belonging to the anal and the other half to the median field of the wing. Since, however, it contains in itself no nervures and has become also of a more or less coriaceous texture, its posterior portion cannot take part in the plications of the anal field; moreover, it has expanded apically and now forms the entire tip of the wing, producing at its upper limit a slight excision of the edge similar to the normal emargination at its lower limit. When the anal field-fan is closed and lies at rest beneath the anterior part of the wing, this triangle, reduced to half its size by a single fold, lies beyond the edge of the wing, and either folds back again upon the upper surface of the wing or curls up in the same position and is thus wholly concealed by the tegmina. When this triangle has enlarged still more, as in the East Indian *Prosoplecta coccinella* (Figure 30), the nervules on either side of it have been forced,

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[1] Figures 29–40 have been generously forwarded by Dr. de Saussure for the illustration of this paper.

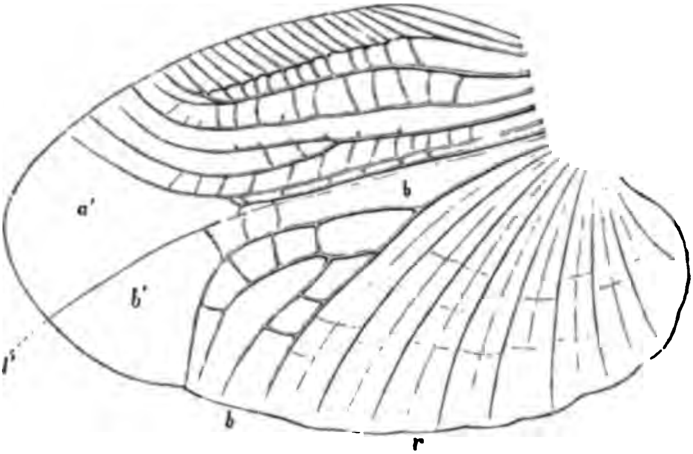

FIG. 30.

as it were, to curve upward or downward to give it room; those below the triangle have undergone a still more remarkable modification to which we shall again allude. In further steps this triangle expands still more (Figure 31, *Plectoptera porcellana* of Cuba), throwing the veins on either side of it farther and farther back, until they fall into a single straight line at right angles to their former direction, one being turned upward, the other downward; and as this line marks the crease where in *Ectobia lapponica* the triangle was folded back upon the top of the wing, so now the wing, having first been folded longitudinally throughout its entire length (the hinder portion lying beneath the upper), has its tip folded over, not far beyond the middle, upon the upper surface of the wing.

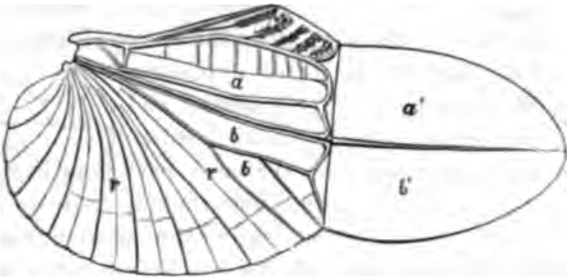

FIG. 31.

It may here be worth while, by the aid of diagrams, to explain a little more carefully the mode in which the wings are folded. Figure 32 may represent a fully expanded wing, such as that last described; *ab*, *a'b'* (*p* of Figure 29) may be called the principal part of the wing, and *r* the diverging field; the bent longitudinal line, separating the anterior zone (*aa'*) from the reversible zone (*bb'*) is the principal longitudinal fold of the wing, to which we have constantly referred; the straight line separating the basal (veined) portion of the wing (*ab*) from the apical (coriaceous) reflectible portion (*a'b'*) is the transverse fold, which in the simpler wings is represented by the upper and lower margins of the apical triangle. The diverging field (*r*) first folds like a fan, so that *b* and *r* together are no broader than *a*; the wing then folds longitudinally, *bb'* bending downward beneath *aa'*, and presents the appearance seen in Figure 33, where *a* and *a'* are alone visible; *a'* now bends upward and folds back upon *a*, as in Figure 34, and the wing is reduced to a little pad, which scarcely surpasses the basal portion of the anterior zone *a*.

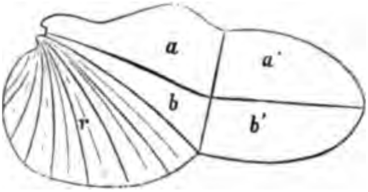

Fig. 32.

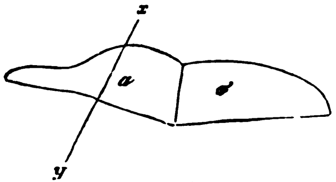

Fig. 33.

Figures 35 to 37, which represent a theoretical section of the wing along the line *xq* (Figure 33), will explain still further this mode of duplicature. In Figure 35 the wing is fully expanded, and *c* represents the costal, *z* the posterior border of the wing; *a*, *b* and *r* represent the same part as in Figure 32, *p* the longitudinal fold or plication separating the anterior from the reversible zone, and *q* the point of division between the reversible zone and the diverging field. In Figure 36 the first step is seen, namely, the result of the plication along the longitudinal fold *p*; Figure 37 (in which the letters bearing primes represent the same parts in the reflectible portion as the equivalent letters in the basal portion of the wing) carries the process to its completion. Figure 38 represents a horizontal section of the completely folded wing; *o* is the anterior, *o'* the posterior articulation of the wing; *o' v* represents the diverging field, *o' t'* the basal portion and *t' e'* the

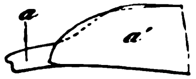

Fig. 34.

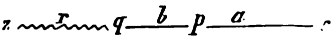

Fig. 35.

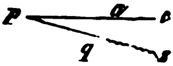

Fig. 36.

reflexible portion of the reversible zone; and *ot*, *te* the corresponding portions of the anterior zone.

There are further modifications of this duplicature; thus in some types, the anal field being ample, a simple fan-like closure of the anal area is not sufficient, and its whole mass is again folded longitudinally and lies not only beneath the under surface of the anterior part of the wing, but beneath the reversible zone or anterior part of the anal area. This may readily be seen on examining Figures 39 and 40 (cf. figures 36 and 37) in which the diverging field *r* or *qz* is bent upon *pq* and lies beneath all the other folds of the wing. Add to this the reversal of the tip of the wing, and by a single stroke of the knife, one may cut through five layers of membrane, not counting the fan-like plications of the anal area which might be severed.

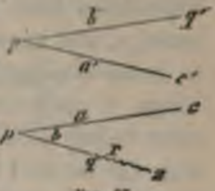

Fig. 37.

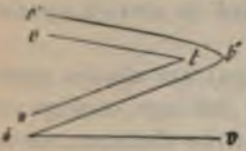

Fig. 38.

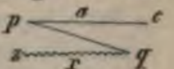

Fig. 39.

There is another curious fact; namely, that when the apical triangle has reached or nearly reached its maximum development, as in *Prosoplecta coccinella* (Figure 30) and *Plectoptera porcellana* (Figure 31), that portion of the anal field which lies within the transverse fold, and above a line drawn from the socket of the wing to a point near the anal emargination (*i. e.*, the basal portion of the reversible zone, *b*, *b*), assumes a venation precisely analogous to that of the upper half of the wing with all its distinct cross-veins and odd reticulations; this becomes possible because it is no longer folded with the rest of the anal field, and does not require simple longitudinal veins. When situated above the anal emargination its relation to the anal area is almost entirely disguised. Even further than this: in some types, as in the Australian *Diploptera silpha*, the terminal reversed area, a simple development of the apical triangle, is filled with a net-work of secondary veins, wholly similar to those of the parts toward the base, and in some instances (but for the transverse fold) direct continuations of them; were the steps unknown by which such a mode of wing-duplicature had been produced, and *Diploptera silpha* the sole living example of such duplicature, the structure of its wings would be utterly incomprehensible on

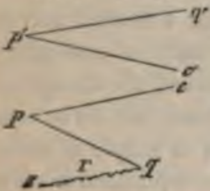

Fig. 40.

the hypothesis of any unity of type in the wing structure of insects.

But these later developments in the modification of the veins themselves have no bearing upon the structure of the wings of earwigs, and have only been introduced for their own interest and to complete the account we have given of duplicature in the wings of cockroaches. We may, however, keep the last statement before us when we recall the fact that the wings of all earwigs (so far as I have been able to determine after an examination of many types otherwise diverse) are identical in their general structure and wholly different from those of any other insects, having been extraordinarily modified to serve a special purpose.

In these insects the fore wings (tegmina) are always small and generally but little longer than broad, although earwigs are invariably slender, and the tegmina, to cover the abdomen, would need be very long. The wings, when folded, generally extend a little beyond the tegmina, and the parts which protrude are coriaceous and wholly devoid of veins ; being moreover frequently ornamented with a colored spot or stripe, and thus further resembling the tegmina, they might be taken for a second pair of tegmina precisely like the first, or differing only in a slightly increased length ; even if the tegmina are removed the deception remains, for the parts of the wings then exposed are coriaceous to the base. These wings, however, are quite as ample as those of other Orthoptera of equal size ; but, by a complicated system of duplicature, accomplished by the mere elasticity of the parts, they are in a few seconds packed snugly beneath the pad-like tegmina, out of danger of abrasion or rupture, as the insect seeks the hidden recesses and crevices where it passes the larger part of its existence.

The most extraordinary thing about the structure of the wings is the immense extent of the anal area ; not only does this reach from base to apex of the wing, as in the extreme type of cockroaches, but the entire wing, excepting only a portion about equalling the area of the tegmina, is made up of this field ; the portion which does not belong to it is almost entirely coriaceous, so that nearly all the nervules of the wing belong to the anal vein. In the hind wings of Orthoptera in general, this anal vein may be roughly described as consisting of a basal arc to which the bases of the various rays are attached one beneath another ; or, rather, the enlarged bases of these rays, lying one beneath another, constitute the arc. This basal arc is closely attached to the lower articulation of the wing with the body in the other families of Orthoptera; but in the earwigs one of these veins, the second from the attachment (see Figure 41,[1] which represents the wing of *Labidura riparia*, common in Europe and America) extends out nearly to the middle of the wing, emitting on the way one or two inferior branches; and, curving upward to the front border just beyond the coriaceous part of the wing (from which it is separated anteriorly by an incision), forms at this point, about the middle of the front border of the wing, the base for the attachment of the diverging rays, which sweep around the entire extent of the wing. The wing may then be said to have two bases; one the point of attachment of the whole structure to the body; the other, the pivot in mid-wing, around which the extensible major part of the wing plays. The radiating veins as well as the independent veins which arise between them, show a further peculiarity in having near the middle a considerable expansion, generally accompanied by an equivalent tenuity, so as to make the wing appear delicately coriaceous in a narrow circuit parallel to the outer border and about midway between it and the hinge or pivot in mid-wing. As to the other veins of the wing, their importance is too slight to be worthy of consideration in this connection; they occupy but a narrow area bordering the coriaceous base of the wing and are present only to an extent sufficient to indicate with certainty that it is the anal vein, to which the mass of nervules must be referred. The anomalous structure of the wing is at once seen on comparing it

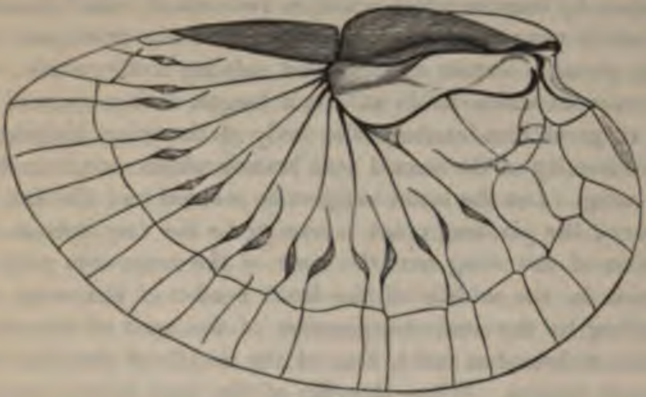

Fig. 41.

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[1] Which we owe to the kindness of Mr. Edward Burgess.

with the wing of a cockroach, its nearest ally, and the purport of the anomaly will appear when we examine carefully the closure of the wing.

Suppose this wing expanded to its utmost. It is retained in its place by muscles which act upon two sets of veins ; an anterior set which supports the coriaceous base of the front part of the wing, giving a certain strength and solidity to the whole ; and a posterior set which holds at arm's length, as it were, and therefore at great disadvantage, the body of the wing, hinging upon the extremity of the second anal branch which runs from base to mid-wing. Let the latter support be relaxed and the fan closes at once ; the pivoting point is seen to be the very bottom of the incision of the wing next the apex of the coriaceous portion, an incision in the middle of the front border of the wing, corresponding to the anal emargination of the apex of the wings of certain cockroaches and to that of the middle of the hind border of most insects. When this fan of the anal field is closed, the plications are brought beneath that portion of the wing which lies between the extended vein which supports the rays and the lower edge of the coriaceous base of the wing. Since the coriaceous base does not extend quite to the middle of the expanded wing, the wing by this process is at once reduced to less than half its length ; and the former apex for the same reason now overlaps the base and rests beside it against the body ; the width of the wing being also reduced, the entire area is now less than one sixth its former extent. As the wing continues to close, the lower half, with its tightly plicated membrane, folds longitudinally beneath the coriaceous basal portion, so that the plications are completely encased, like leaves in a book, between a coriaceous upper layer and the thinner membrane of an equal portion of the wing lying, when the wing is expanded, directly behind it ; the apex of the wing, however, now lies in even a worse position than before, directly beneath the root of the wing ; or would do so, but having by this last movement been turned upside down, its elasticity allows another movement which its very position before prevented ; and we now perceive the meaning of the expansion and tenuity of the radiating veins in points arranged in a circuit parallel to the outer border ; on the folding of the wing these are brought together, and it is just here that the apex of the wing, which is apparently so much in the way, now bends transversely downward beneath the remainder of the wing, and the whole is reduced to less than a tenth, probably less than a fifteenth, of its former extent. The anterior supports are now relaxed, the wing assumes its natural position, the wing-cover closes down upon it, and all is snugly packed away.

Although I have never experimented upon a living earwig, it will be apparent to any one who has attempted to expand a wing rendered flexible by artificial means, that the closure of the wing is produced by the mere elasticity of the parts. It is also altogether analogous to the process of duplicature in the cockroach, as carefully explained by Saussure, and it is difficult to explain the process in any other way. The mode in which they are opened would be much more difficult to understand if it had not been observed by Charpentier and described nearly forty years ago. The contraction of the extensor muscles attached to the hinder set of veins would undoubtedly cause the fan to expand when once the double folding, transverse and longitudinal, had been overcome; but it does not seem possible that they could cope with this difficulty. How then is it done? According to Charpentier, simply by means of the forceps with which the extremity of the abdomen is always provided in both sexes; the tip of the body is bent upward and the forceps used with great rapidity and ease, first on one side and then on the other, as a sort of fingers, to bring the wings into the position which would allow the action of the thoracic muscles upon the base of the principal veins. Nevertheless, it is difficult to conceive how this operation can be performed by those species whose forceps are as long as their body.

COOPER'S HELIX IN COLORADO.

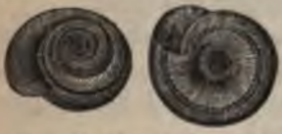
BY E. A. BARBER.

AMONG the Helices, there is perhaps no species which presents greater diversity in form, size, and markings, than *Helix Cooperi.* Until recently, our knowledge has been somewhat limited in regard to this beautiful and interesting western species; but our information has been materially increased of late, by the results of the researches of the United States Geological Survey. During the summers of 1874–75, I found great quantities of these shells throughout Colorado, in a variety of locations, and under variable conditions. I first discovered them in Middle Park, a few miles from the Hot Sulphur Springs, or the settlement known as Grand City, on the head-waters of the Grand or Gunnison River. As we were riding along through a severe hail-storm, we crossed over a hill which was literally covered with white objects, which I at first supposed to be hail-stones, but which I soon perceived were weather-worn shells of this species. Hastily dismounting, I scooped together, from a space scarcely two feet square, over a pint of them, which I carried back to camp for examination. They were so numerous that half a bushel could have been raked together without difficulty in a very short time, but they seemed to be confined to this particular elevated mound. All were dead, being in a dry, exposed situation, and but few of them were worth preserving. This was at an altitude of about 8500 feet, although I have found numbers of these shells just below the timber-line on the summits of mountains, 11,000 feet above tide water. Such specimens were usually more fully developed, although I never found them in a living state above 9500 feet. And here I may add that I have never discovered a single specimen on the eastern or Atlantic slope, and I have yet to see the first sample which was discovered there, although I do not assert that *H. Cooperi* does not occur on this side of the Range.

Along the banks of small streams and springs, in the damp sedge and grass, and in shaded spots, I found many, but rarely more than a dozen together. All of these latter were in a living state, and on extracting the animals from the shells, I found that they were viviparous, nearly every one containing about twenty-five minute, well-formed shells. In the cañons cleft in the mountain sides, among the dank underbrush, the most brilliantly colored specimens were obtained, each being marked with longitudinal or spiral bands of dark red or brown, varying in number from one to five, but usually two. In some instances the entire shells were dark, with the exception of a narrow, bright-colored band.

Through North Park they are abundant, and farther west, along the Bear (or Yampa), White, Grand, and Eagle (Piney Creek) Rivers. Near the South Branch of White River I discovered a locality, on the summit of a high hill, abounding in quantities of a larger variety of this species. The individuals were, some of them, as large as an average *Helix albolabris*; but all of these were empty, and bleached perfectly white. The shells were depressed, and thick and heavy. In the same neighborhood (as in fact, throughout the most of northwestern Colorado), bleached shells are scattered over the surface of the ground in such quantities that the traveler may pick up, almost anywhere, quarts of them. In particular places the soil is strewn so thickly with them that one can scarcely walk without crushing several at every step. Where they occur so numerously the shells are invariably empty and bleached, and in all probability they have been lying in this condition for years. Through burned forests where every tree has been charred, and the underbrush entirely destroyed, they are to be seen, lying on the blackened ground, in even greater quantities than under any other condition. And this I accounted for in the following manner: At certain times of the year the animals bury themselves in the moist earth, and when the forests are fired by the Indians, the heat causes them to come to the surface, where they are destroyed, and their calcareous coverings rendered so brittle that they can be crumbled into an impalpable dust between the thumb and fingers.

Different specimens of *H. Cooperi* often present such a great variety of forms that the collector may frequently become confused in seeking to determine them. Sometimes the spire is exceedingly depressed, when the specimen may be mistaken for *Helix strigosa*, while many others are highly elevated and resemble closely large specimens of *Helix Idahoensis*. Near the Grand River, just above its confluence with Piney Creek, I picked up a reversed specimen, which, among this species, is extremely rare. It must be considered as nothing less than a montrosity, yet is exceedingly interesting in showing to what extreme variation the *H. Cooperi* is subject.



(FIG. 42.) REVERSED SPECIMEN OF HELIX COOPERI.

As we advanced southward we found the representatives of this species decreasing in number and size, until, in the southwest portion of Colorado, they are found only occasionally in the defiles of the Sierra La Plata. The higher elevations seem to be more favorable for the full development of mollusks, being a limestone country, while among the lower sandstones land shells are almost unknown. We find, then, that there are certain conditions of climate, elevation, and locality, which are favorable to the satisfactory growth of the hardy and prolific *H. Cooperi*. It seems to thrive better in a temperate than in a torrid climate. It increases more rapidly in numbers, and even in size, in the medium or higher altitudes. It prefers cool, damp, shaded spots, to warm or dry locations. It appears to be confined to the Pacific slope of the Rocky Mountains; for, if it exists at all on the eastern side, it is only met with in reduced numbers.

MICROSCOPES AT THE LOAN COLLECTION OF SCIENTIFIC APPARATUS OF THE SOUTH KENSINGTON MUSEUM.

BY JOHN NICHOLS.

AMONG the relics of early microscopy, the compound microscope, invented and constructed about 1590, by Zacharias Janssen, of Holland, is certainly a very primitive affair. As this, and in fact all the other instruments are inclosed in a glass case, a critical examination is impossible. The outward form presents the simple appearance of an iron or tin tube about ten inches long and about an inch and one half in diameter; the magnifying power is very moderate.

In the same case is a silver microscope, by Anthony van Leeuwenhoeck (born 1632, died 1723), the noted Dutch philosopher and microscopist. It may be remembered that he made a microscope for almost every object, which must have consumed much of his valuable time. This microscope of Leeuwenhoeck's is simple in form, being a silver plate, perforated with a single minute hole, in which is fixed a tiny lens, in front of which, and in focus, is placed a silver needle upon which the object was fixed.

It was with such an instrument that Leeuwenhoeck carried on his wonderful discoveries, and laid the first steps in histological science. What glorious results might have followed had he possessed a modern instrument and objectives!

The great microscope made by Benjamin Martin (1770), for George the Third, is probably the largest and most elaborate instrument ever manufactured. It stands nearly three feet high, and is decorated with much scroll-work, while in all directions are lying the most complicated pieces of accessory apparatus, which must have sorely bewildered the royal scientist. Looking at this piece of scientific magnificence, some comfort is suggested, that if we have not yet reached perfection in designing microscopes, we have at least attained a good degree of simplicity of construction.

There are many other instruments made by the early microscopists, illustrating the progress of the instrument. That made for or by Galileo is of special historical interest. The glasses have been lost; the tube alone remains. The body is an upright, supported on a tripod.

The modern instruments offer no field for comment. One looks in vain for anything novel in construction. There are the well-known forms of the different makers enclosed in glass cases. Probably the London shop-windows present as great a variety in microscopes as this section of the collection. The instruments are all muddled together without any order or attempted arrangement.

Powell and Lealand do not exhibit. Messrs. Ross & Company exhibit a large instrument on the Jackson slide principle, designed by Mr. F. H. Wenham. The great point in this form is, that the fine adjustment is placed under the instrument, and can be reached without taking the hand from the coarse adjustment. Thus the old objection to this model has been removed. Messrs. R. & J. Beck also have one of their best microscopes, showing great perfection of work; also a cheap form called "The Economic." It is monocular, highly finished, and is altogether a charming instrument and furnished for five and six guineas, with objectives and case.

Mr. Stephenson exhibits his erecting binocular microscope, for which he claims many decided advantages, which should make it extremely useful. The instrument of the future, the comfort of looking through inclined tubes and still having the stage horizontal, and the image in its natural position, certainly marks a great advance in construction.

Mr. J. Browning shows a microscope upon the same model, but with what is claimed to be an improvement. In this instrument, for the first time, the planes introduced by Mr. Stephenson for altering the direction of the rays, so that the microscope can be used with the stage in a horizontal position, have been introduced near the eye-piece in the separate bodies. This arrangement will, it is believed, be found to possess considerable advantage. Such is the official description, which must be taken for granted, as the exterior presents no novel feature.

Swift, who is turning out some of the best moderate-priced optical instruments in London, shows a microscope very similar to Messrs. Beck's "Economic," called the "New College Microscope." Also a new crane arm-binocular. This is an excellent full-sized instrument, and for a good, working microscope, appears all that can be desired, and sold with good objectives at a price within the reach of the student microscopist.

The German manufacturers have sent a few instruments, and are chiefly represented by Messrs. Tiebert and Krafft, and E. Leitz, both of Wetzlar. Respecting these microscopes I noticed nothing special, except that they appeared inferior in workmanship to those exhibited by the London makers.

Among accessory apparatus will be found that used by Messrs. W. H. Dallenger, and J. J. Drysdale, M. D., for the continuous observation of minute organisms. Those who read the *Monthly Microscopical Journal*, know what valuable results were obtained by its use. Would that the faculty to make use of instruments could be sold to the many purchasers.

Microtomes, for cutting sections, are here in great variety and of all sizes. One with a marble basin larger than an ordinary washing-basin. In some of the microtomes the knife is fixed and worked by a piece of mechanism like a lathe rest, such as that made by W. Apel, mechanician to the University of Göttingen. In another microtome the preparation is pressed forward by a micrometer screw, against a circular knife, set in motion by a lathe. This instrument is from the University of Prague.

United States opticians and manufactures are totally unrepresented, which is much to be regretted, as in this section they could have made an excellent show, — perhaps have carried off the palm.

MIMICRY IN BUTTERFLIES EXPLAINED BY NATURAL SELECTION.

FRITZ MÜLLER, whose contributions to science are always worthy of special attention, endeavors in a recent German periodical[1] to show how the phenomena of mimicry in butterflies may be explained by the theory of Natural Selection. He bases his inquiries upon the species of *Leptalis* found in southern Brazil, and although, as will appear below, he adduces reasons for believing the primitive stock to have been banded, and not like most of the family to which this genus belongs, simple white butterflies, he commences by showing how even such an extreme change could be wrought out by the survival of the fittest in the struggle for existence.

"Should," he remarks, "the first unimportant variations from the original white color (of the Pierids) be useful only in attracting to their possessors, at a little shorter distance, the attention of enemies flying carelessly overhead, they would become more and more useful, and cause their possessors to become continually more abundant in proportion to the type; they could therefore serve as the basis for the gradual formation of a resemblance fit to deceive even the sharp eyes of birds scanning the swarms of Ithomias (the butterflies imitated by some Leptalids) for booty."

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[1] Jenaische Zeitschrift für Naturwissenschaft, x. i., February, 1876.

Farther on he asserts that "the acceptation, as the starting-point in the origin of mimicry by natural selection, of a resemblance having its beginning at such a distance can scarcely be shaken by a single known case. It should, moreover, not escape attention that the sharp-sightedness of enemies is itself also a quality at first gradually acquired in the struggle for existence, and one which must increase, from the very fact that by protective coloring, mimicry, etc., the persecuted species escapes the less sharp-sighted pursuer. This ever-increasing sensitiveness and sharp-sightedness of the pursuer on the one hand explains the wonderful completeness of many natural imitations, and on the other makes the acceptation of an originally very slight resemblance the less hazardous."

Fritz Müller insists, as all writers on the subject have done, upon the similar geographical distribution of the imitating and the imitated species as a necessary concomitant of mimicry; but instead of believing with other authors that the Leptalids have become poor flyers in their imitation of the feeble-winged *Ithomia*, he holds that the wretched powers of flight possessed by the species of *Leptalis* have been the very cause of mimicry; the insects needed mimicry the more the poorer flyers they were.

Mimicking species of course stand between their original type and the mimicked species; and since mimicry is often confined to the female, we should expect in such cases to find the following series: original form, male of mimetic species, female of same, species mimicked.

In his vicinity, Müller has found five species of *Leptalis*, of which only four are common, and are discussed by him. Of these four, *Lept. Melia* mimics nothing; all the other three are imitative species and mimic distinct groups of butterflies; *Lept. Astynome* resembling a Heliconian-like Danaid, *Mechanitis Lysimnia;* another, which he calls *Lept. Thalia*, mimicking an Acræan, *Acræa Thalia* so closely, that Müller at first supposed it to be an Acræan; and the last, *Lept. Melite*, bearing a close resemblance to the female of one of its own family, *Daptonoura Lysimnia.*

A comparison of the form of the wings of these different insects shows the following series: —

(1.) *Pieris* or *Daptonoura*, *Mechanitis Lysimnia*, *Leptalis Astynome* ♀, *Leptalis Astynome* ♂, *Leptalis Melia.*

(2.) *Pieris* or *Daptonoura*, *Acræa Thalia*, *Leptalis Melia.*

(3.) *Pieris* or *Daptonoura*, *Leptalis Melite* ♀, *Leptalis Melite* ♂, *Leptalis Melia.*

In all these series, *Pieris* (or *Daptonoura*) stands at one end and *Leptalis Melia*, a banded species, but one which, as already remarked, does not imitate any other butterfly, at the other. The mimicking species always stand between the species they imitate and *Leptalis Melia*, and where there is a difference in the sexes, the females resemble most the imitated species, the males *Leptalis Melia*. From this Müller reasonably urges that the original *Leptalis* stock, from which the mimicking species were derived, was allied to *Leptalis Melia* rather than to a *Pieris*, or *Daptonoura*, and that therefore, at the very start, natural selection had the advantage of finding a pliable stock already resembling not a little the bird-shunned Ithomias.

From this he proceeds to a comparison of other relations between the mimicked species, the mimicker, and the non-mimicking *Leptalis*, and discovers that in every instance, and in each particular, the mimicking *Leptalis* stands between *Leptalis Melia* and the mimicked Danaid, Acræan, or Pierid; even in one instance the neuration of the mimicking species is decidedly altered, showing how seriously the structure may be affected by mimicry. Müller studies separately the form of both fore and hind wings, the pattern and coloration of all, entering into many very interesting details, and elucidating the different points by the aid of simple but sufficient illustrations, which our readers will find well worth examining.

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PROGRESS OF ORNITHOLOGY IN THE UNITED STATES DURING THE LAST CENTURY.

BY J. A. ALLEN.

EARLY PAPERS.

PRIOR to the year 1808, when the first volume of Alexander Wilson's great work was published, little had been written on American birds by Americans. A few lists of the birds of limited portions of the United States that appeared during the last fifteen years of the eighteenth century constituted our whole ornithological literature at that date. The first of these was a list of about one hundred and twenty species, published by Thomas Jefferson in 1787, in his celebrated Notes on Virginia. This is a catalogue of the species described by Catesby, with the addition, in parallel columns, of the Linnæan and common names, and of the popular names of a few species not described by Catesby, — merely a nominal list of no special importance. This was followed, in 1791, by William Bartram's enumeration of the birds known to this excellent naturalist as inhabitants of the eastern portion of the United States, published in his Travels in North and South Carolina, Georgia, East and West Florida, etc.; this list embraced about two hundred and fifteen species, and, though mainly a nominal one, was accompanied by typographical signs indicating the range of the species at the different seasons of the year, while a few were described at some length in other parts of the same work. In many cases Linnæan names were used for the designation of the species; but to the larger number he gave new names, which, being generally unaccompanied by descriptions, are now to a very large extent undeterminable. This paper is especially noteworthy as forming the first important contribution by an American to American ornithology.

The next paper in order of time was by Jeremy Belknap, who in his History of New Hampshire (vol. iii.), published in 1792, devoted ten pages to birds, giving a list of about one hundred and sixty species. The current Linnæan names were used, to which a few new names were added. Although no descriptions are given, the names generally clearly indicate the species meant. Though not commonly referred to by scientific writers, it forms a highly important paper and one worthy of attention. Samuel Williams, in his Natural and Civil History of Vermont (published in 1794), devoted also about the same number of pages to the birds of Vermont. Scientific names of about fifty species are given in full, and the generic names of a dozen others. The paper also embraces a number of pages of valuable notes. These two last-named articles show that several species were then common in New Hampshire and Vermont that long since became extinct there, and are hence papers of considerable historic interest. In 1799, Benjamin S. Barton published his Fragments of the Natural History of Pennsylvania; this rare folio contains a list of the birds of Pennsylvania, with notes on their migrations.

Although John Clayton published a valuable paper on the birds of Virginia as early as 1693 (Philosophical Transactions, vol. xviii.), and although many enumerations of a few of the birds of many portions of the Atlantic States, from Florida to Maine, were made by different writers during the seventeenth and eighteenth centuries, some of which possess especial value in a historic point of view, the four papers already mentioned constitute the bulk of the ornithological literature written by Americans prior to the time of Alexander Wilson.

GENERAL WORKS.

Alexander Wilson, a Scotchman by birth, came to America in 1794, and some ten years later conceived the idea of writing a history of the birds of his adopted country. Receiving hearty encouragement from his kind friend, Mr. William Bartram, he entered seriously upon his great work in 1805, to which he devoted almost his whole time and energy till his untimely death in 1813. The first volume appeared in 1808, followed by eight others, the last two of which were published after his death, under the editorship of Mr. George Ord. Of these nine folio volumes, accompanied by colored plates, Bonaparte wrote in 1825 as follows: "We may add, without hesitation, that such a work as he [Wilson] has published in a new country is still a desideratum in any part of Europe." His earlier figures were sometimes stiff and awkward, but they were generally of a high grade of excellence for that time, and his descriptions were concise and exact. His accounts of the habits of many of the species have rarely been surpassed in point of truthfulness or felicity of expression. Never extended by irrelevant matter, some of them are models of descriptive writing, evincing a poet's love and appreciation of nature. Although adopting Pennant's system of classification, by far the best then extant, the species were not systematically grouped, but taken in the order in which they most conveniently came to his hand. Had he lived to complete his work, many others would doubtless have been added, and the whole rearranged in accordance with his own ideas of their affinities.

The work so well begun by Wilson was continued by Bonaparte, whose American Ornithology, or the Natural History of the Birds inhabiting the United States, not given by Wilson, was extended to four volumes, similar in style to those of Wilson. The first appeared in 1825, the second and third in 1828, and the fourth in 1833.

Several editions of Wilson's work were subsequently issued, either separately or combined with Bonaparte's continuation. The first American edition was that published by George Ord, in 1828–29, in three octavo volumes of text and a folio volume of plates. In this work the species are arranged systematically, but the editor adhered to the original text, correcting merely a few erroneous references and verbal inaccuracies. In 1831, Jameson published in Edinburgh an 18mo edition of Wilson's and Bonaparte's works. The succeeding year this was followed by Jardine's edition (London and Edinburgh, 1832), in three octavo volumes, of the same authors. This last was reissued in this country in 1840, in one volume, with the addition of a Synopsis of the Birds of North America, by Dr. T. M. Brewer. Of this there were subsequently several reprints from the same stereotyped plates.

In 1827, John James Audubon began the publication of his celebrated work on North American birds, which was not completed till 1839. The whole work forms five octavo volumes of text, with an elephant folio atlas in four volumes of four hundred and thirty-five plates. The text was published in Edinburgh, with the title of Ornithological Biography; the plates in London, as Birds of America. This magnificent work remains as yet unequaled in respect to its illustrations, which are unrivaled in point of accuracy and life-like character, the birds being all represented of the size of life. In his animated descriptions there is at times a tendency to exaggeration and redundancy of personal incidents. The species are arranged according to the convenience of the author, a systematic arrangement being in such a work obviously impracticable. In 1839, however, on its completion, the author published his Synopsis of the Birds of North America. In this work the nomenclature is revised and greatly changed, principally through the adoption of many of the then recently introduced generic designations. This Synopsis (one volume, octavo, Edinburgh) was a methodical catalogue of all the species at that time known to inhabit North America north of Mexico, and was intended to serve as a systematic index to his Ornithological Biography, and Birds of America. The work, however, is much more than this, giving, as it does, the characters of the families, genera, and species, the range of each species, and numerous bibliographical references. It includes also a few species not given in his larger works.

Subsequently Audubon republished his Ornithological Biography, and Birds of America in a single work, under the title of Birds of America. This is simply a reissue of the text of the former, with the species systematically arranged under the names employed in the Synopsis, and the addition of the plates of the large folio work, reduced by the camera lucida. This work was published at Philadelphia (1840 to 1844), in seven imperial octavo volumes. It has also been since republished in New York, with chromo-lithographic illustrations of a character far inferior to those of the original work. The appendix to the seventh volume includes a few species previously unpublished by this author.

In 1832 appeared the first volume of Thomas Nuttall's Manual of the Ornithology of the United States and of Canada, embracing the land-birds. This was followed in 1834 by the second volume, devoted to the water-birds. A new edition of the land-birds was published in 1840, including all the species discovered in the mean time by Townsend and Audubon. These two volumes (12mo, Boston), illustrated with numerous small wood-cuts, contain a succinct history of the birds of North America known at the time of their publication, and, being written in a pleasing style, form a work that has been deservedly popular, despite many inaccuracies, and has recently been republished.

The next general work on the birds of North America was John Cassin's Illustrations of the Birds of California, Texas, Oregon, British and Russian America. This was published in parts (Philadelphia, 1853–55), and was intended to contain descriptions and figures of all North American birds unfigured by previous authors, and a general synopsis of North American ornithology. It was issued in ten parts, with fifty plates. The author's plan of continuing the work was probably superseded by the preparation soon after of a far more important work, in the labor of which Mr. Cassin shared.

Dr. T. M. Brewer's North American Oölogy (Smithsonian Contributions, vol. xi.), published in 1857, is the only American work devoted exclusively to the eggs and breeding habits of North American birds. It is, however, as yet uncompleted, Part I. (quarto, pp. 140) embracing the *Raptores* and *Fissirostres*, being the only portion yet published. The five colored plates give figures of the eggs of all the species of these groups at that time accessible, while the text contains a very full account of the distribution and breeding habits of the species embraced.

In 1858 appeared the well-known General Report on the Birds of North America, forming volume viii. of the Pacific Railroad Reports of Explorations and Surveys. This was the joint work of Spencer F. Baird, John Cassin, and George N. Lawrence, the parts devoted to the *Raptores*, *Grallæ*, and *Alcidæ* being by Mr. Cassin, while Mr. Lawrence wrote that relating to the *Longipennes*, *Totipalmes*, and *Colymbidæ*, the remainder being by Professor Baird, the whole work making a quarto volume of over one thousand pages. The abundant material at the command of these eminent authors, and the elaborate and critical manner in which it was treated, render this work by far the most complete and important, in a scientific point of view, that had at that time appeared relating to North American ornithology, or, in fact, to any similar area anywhere. It is, however, a strictly technical treatment of the subject. The special reports on the ornithology of the different routes explored, contained in other volumes of this series of reports, supplemented this general work with much biographical matter, in connection with which appeared thirty-eight finely executed colored plates of species described in the general and special reports, but previously unfigured by American authors. This was followed in 1859 by Professor Baird's report on the Birds of the United States and Mexican Boundary Survey, with twenty-five admirable plates of previously unfigured species. In 1870, the text of the General Report was re-issued, with some additional matter, under the title of Birds of North America, with an accompanying volume of one hundred plates, including those above-mentioned as accompanying the special reports of the Pacific Railroad and Mexican Boundary Surveys.

In 1864 Professor Baird began the publication of his Review of American Birds (Part I. North and Middle America, Smithsonian Miscellaneous Publications, No. 181). Installments of the work were published at intervals during the next two years, the last signature bearing the date of "June 9, 1866." The work, so far as published, forms an octavo volume of 450 pages, taking the *Oscines* as far as the genus *Collurio*. The very thorough character of this much-needed work renders it a source of sincere regret that its busy author has not found time to carry it forward to completion.

In 1869 appeared D. G. Elliot's work (two volumes in one, folio, New York), entitled New and Unfigured Species of the Birds of North America, containing sixty-four colored plates, and short critical notices of one hundred and fourteen species. This was followed in 1870 by Cooper's Birds of California, edited by Professor Baird "from the manuscript and notes of J. G. Cooper." We have as yet of this important work only the first volume (forming volume i. of the Zoölogical Reports of the Geological Survey of California, Professor J. D. Whitney, director), embracing the land-birds. This is a quarto of six hundred pages with life-size colored figures of the heads of each species and small full-length figures of some species of each genus, *inserted in the text.* This method of illustration was novel and advantageous to the student, the work being intended as a manual of the ornithology of the whole region west of the Rocky Mountains north of Mexico.

The next general work on North American birds is Dr. Elliott Coues's Key to North American Birds (one volume, quarto, with upwards of 250 wood-cuts and six steel plates), published in October, 1872. This highly useful and deservedly popular work is unique in ornithological literature, being a manual of the birds of North America, designed especially for the use of students, in which are introduced analytical tables for the determination of the species, similar in character to those so successfully adopted in botanical text-books. This was followed, in 1874, by the same author's Field Ornithology and Check-List of North American Birds, intended as a supplement to the Key, the first part being a "manual of instruction for procuring, preparing, and preserving birds," and the latter, as its title implies, a "check-list" of the species.

By far the most important recent work on North American ornithology, however, is the joint work of Prof. S. F. Baird, Dr. T. M. Brewer, and Mr. Robert Ridgway, published under the title of Birds of North America. The first three volumes of this indispensable work, embracing the land-birds, appeared in 1874, the portion relating to the water-birds being still in course of preparation. The more technical portion is the joint work of Professor Baird and Mr. Ridgway, while the biographical portion is written by Dr. Brewer. This work, it is needless to say, represents the most advanced views of our best authors, and must long remain the leading authority on the subject of North American ornithology. It is illustrated with five hundred and ninety-three wood-cuts, devoted largely to the external anatomy, and sixty-four colored plates giving life-size figures of the heads of the greater part of the species and varieties. Later works possessing a general character are Dr. Elliott Coues's Birds of the Northwest (1874), and Mr. H. W. Henshaw's recent Report (1875) upon the ornithological work of the Survey of the Territories West of the One Hundredth Meridian. The first of these is an octavo of nearly eight hundred pages, forming No. 2 of the Miscellaneous Publications of Dr. F. V. Hayden's Geological Survey of the Territories. The work is intended as a hand-book of the region drained by the Missouri River and its tributaries, and hence embraces a wide field. Giving as it does a summary of the ornithology of this extensive region, combining much new matter with much previously published in scattered papers, and the fullest tables of bibliographical references for the larger part of the birds of North America that has yet appeared, it is a work of the highest value to students of American ornithology.

Mr. Henshaw's work (Chapter III. of vol. v. of the Reports of the Geological and Geographical Surveys West of the One Hundredth Meridian, under Lieut. G. M. Wheeler) is limited to the actual work of the Wheeler Survey, of which it presents a general systematic summary, based on the collections and field-notes made chiefly by the author and Drs. Yarrow and Rothrock, and Messrs. Bischoff and Aiken, and is hence made up wholly of original matter, adding largely to our knowledge of the ornithology of this previously little-known region. It is accompanied by fifteen chromo-lithographic plates of previously unfigured species and varieties, and embraces about five hundred quarto pages of text.

WORKS AND PAPERS OF A SPECIAL OR LOCAL CHARACTER.

The long list of general works by no means comprises all the important contributions made by Americans to North American ornithology. The special papers, many of them of a high scientific value, are too numerous to be mentioned even by name within the limits of the present paper. These number several hundred, varying in length from a few pages to hundreds each. While a considerable proportion are limited to the descriptions of a few new or little-known species, or to the enumeration of the species found at particular localities, others are exhaustive monographs of genera or families, or are devoted to a discussion of general questions of nomenclature, of the geographical distribution of the species, or of laws of geographical variation.

Of papers of a strictly local character may be mentioned the Rev. W. B. O. Peabody's Report on the Birds of Massachusetts (Fishes, Reptiles, and Birds of Massachusetts, 1839); Zadock Thompson's chapter on the Birds of Vermont (Natural, Civil, and Statistical History of Vermont, 1842); J. P. Giraud's Birds of Long Island (8vo, 1844); Dr. J. E. Dekay's Report on the Birds of New York (New York Zoölogy, Part II., one vol. 4to, with colored plates, 1844); E. A. Samuels' Birds of New England (8vo, pp. 600, 1867); C. J. Maynard's Birds of Florida (now publishing in parts); and T. G. Gentry's Life-Histories of the Birds of Eastern Pennsylvania (vol. i., 1876), the two latter still in course of publication. Linsley's Catalogue of the Birds of Connecticut (American Journal of Science and Arts, first series, vol. xliv., 1843), and Wm. M. and S. F. Baird's List of the Birds of Carlisle, Pennsylvania (ibid., vol. xlvi., 1844), are noteworthy, as being the first of a long series of papers of a strictly faunal character that have contributed so much to our knowledge of the distribution of our birds, their periods of migration, and their seasonal ranges throughout the eastern half of North America from Labrador to Florida. For notes on the avifauna of Labrador and Anticosti, we are indebted to Coues, Verrill, and Packard; Drs. Brewer and Bryant have written on the birds of New Brunswick and Nova Scotia; Cabot, Holmes, Boardman, Verrill, and Hamlin on those of Maine, and Maynard and Brewster on those of Maine and New Hampshire; Emmons, Brewer, Putnam, Samuels, Allen, and Maynard on those of Massachusetts; Linsley and Wood, and others, on those of Connecticut; Coues and Brewer on those of New England in general; Lawrence and Fowler on those of New York; Abbott and Turnbull on those of New Jersey; Taylor, the Bairds, and Barnard on those of Pennsylvania; Coues and Webster and Jouy on those of the District of Columbia; Scott and Brewster on those of West Virginia; Burnett, Gibbs, Cope, and Coues on those of North and South Carolina; Bryant and Allen on those of Florida; Kirtland, Read, Kirkpatrick, and Wheaton on those of Ohio; Haymond and Allen on those of Indiana; Kennicott, Pratten, Allen, Ridgway, and Nelson on those of Illinois; Kneeland, Hughs, and Covert on those of Michigan; Head, Trippe, and Hatch on those of Minnesota; Hoy and Barry on those of Wisconsin; Allen, Parker, and Trippe on those of Iowa; Hoy on those of Missouri; Roemer, McCall, and Butcher on those of Texas; Coues, Allen, Snow, and others on those of Kansas; Allen, Aiken, Holden, Trippe, and Henshaw on those of Colorado and Wyoming; Hayden, Cooper, Allen, and Coues on those of the Upper Missouri country; Townsend, Cooper, Suckley and Bendire on those of Oregon; Baird, Allen, Ridgway, and Henshaw on those of Utah; Henry, Baird, and Henshaw on those of New Mexico; Coues, Henshaw, and Yarrow on those of Arizona; Ridgway, Henshaw, and Yarrow on those of Nevada; Xantus, Feilner, Brewer, Gambel, Heerman, Cooper, Ridgway, Nelson, and Henshaw on those of California; and Dall, Bannister, H. W. Elliott, and Coues on those of Alaska. Other writers on the birds of the far West are Say, Woodhouse, Kennerly, Newberry, Suckley, Stevenson, and Merriam.

Among the numerous papers of a critical or monographic character may be mentioned Bonaparte's Observations on the Nomenclature of Wilson's Ornithology, published in 1824–26 (Journal of the Academy of Natural Science, Philadelphia, vols. iii., iv., v.), in which were first introduced into the annals of North American ornithology a large proportion of the generic names now in current use, a few only of which were first proposed in this essay. It created, however, a revolution in the Wilsonian nomenclature. Audubon's Synopsis (1839) again brought down the nomenclature to the date of its publication, through the adoption of the changes made necessary by the further increase of knowledge. The Audubonian nomenclature was generally in use in this country till the appearance of Baird, Cassin, and Lawrence's great work in 1858, when a number of new generic and subgeneric names were proposed, and the nomenclature again modernized. Comparatively few generic names have since been introduced, but revisionary work of a somewhat different character (to be noticed later) has already greatly modified the nomenclature of 1858.

Among revisionary papers of a minor but more general character are numerous critical essays by Cassin, especially on the *Icteridæ* and *Picidæ*, the *Raptores*, the *Cærebidæ*, *Caprimulgidæ*, etc.; by Baird, in his Review of American Birds; by Coues among the *Laridæ*, *Procellariidæ*, *Grallæ*, *Colymbidæ*, *Spheniscidæ*, etc.; by Ridgway among the *Raptores* and by Bannister among the *Anseres*, etc. Of separate monographic papers may be mentioned those of Coues on the genus *Ægiothus*, the *Tringaæ*, *Alcidæ*, etc., Bryant on the genus *Cattaractes*, and Ridgway on various groups of the *Raptores* and *Oscines*, the genus *Leucosticte*, etc.

The anatomy and embryology of our birds have not received the attention these subjects deserve, but a number of papers have appeared treating more or less in detail of particular points. Dr. Coues has published an account of the myology of *Colymbus torquatus* and various notes on the structure of the *Spheniscidæ*; Streets has written on the characters of the skull in birds, and Mr. Ridgway has called attention to various points in the osteology of the *Raptores*. Agassiz and Wyman have noticed a few points in the development of birds, while Prof. E. S. Morse has carefully studied the development of the tarsus and carpus with results confirmatory of the previously suspected affinities existing between birds and reptiles.

Not only has the geographical distribution of North American birds been studied in connection with the general history of each species, but attempts have been made to discover and limit the different faunal areas of the continent, special attention having been given to this department of the subject by Baird, Verrill, Allen, and Ridgway, and incidentally to a less extent by others. The subject of geographical variation has also been thoroughly investigated, with results of high importance, which will later be referred to more fully. Among the prominent workers in this field are Baird, Allen, Coues, Ridgway, and Henshaw, while the subject has received much attention from others.

Within the last ten years also a field previously wholly unexplored has been opened up, that of palæontological ornithology, mainly through the labors of Professors O. C. Marsh and E. D. Cope, the former of whom has alone made known, mostly in preliminary papers, the remains of upwards of thirty species, found in the Cretaceous green-sands of New Jersey, and the Cretaceous and Tertiary formations of Kansas, Colorado, and Wyoming. Those described by Professor Cope are likewise mainly from the same localities.

Much has also been written by American ornithologists on exotic birds, especially on those of Central and South America. In 1838, J. P. Giraud described "sixteen new species" of Mexican birds, and Dr. S. Cabot published (1842 to 1844), several papers on the birds of Yucatan, describing a number of new species. Mr. George N. Lawrence has published numerous papers on the birds of Mexico, the West Indies, and Central and South America, and Dr. Bryant on the birds of some of the Lesser Antilles. Cassin published not only on the birds of Central and South America, but also on those of Africa and other distant countries, including reports on the collections made by the United States Exploring Expeditions under Commodores Rogers and Wilkes. Baird's Review of American Birds treats largely of the birds of tropical America, and some of the monographic and revisionary papers of Coues and Ridgway have taken a wide range. D. G. Elliot has published elegantly illustrated monographs of the *Pittidæ*, the *Phasianidæ*, and the *Tetraoninæ*, and many papers on different genera of the humming-birds and other exotic groups, mostly, however, prepared and published abroad. Professor Alpheus Hyatt has published a monograph of the *Spheniscidæ*, and Drs. Kidder and Coues reports on the birds of Kerguelen Island; the present writer reports on collections of birds made at Lake Titicaca, and at Santarem, on the River Amazons. Prof. James Orton has also published on the birds of Ecuador, and the Rev. J. H. Bruce on those of India.

Among the many aids to a better knowledge of American birds should be mentioned the explorations of Kennicott, Dall, H. W. Elliott, Bannister, and Bischoff, in British North America and Alaska, conducted under the auspices of the Smithsonian Institution, several of whom have forwarded to Washington immense collections of the birds of the Northwest. The surveys of our western Territories made under the direction of the War Department should be especially mentioned as among the auxiliaries of ornithological science in this country, the various government expeditions having been usually accompanied by competent naturalists. The recent surveys (still fortunately in progress) under the Department of the Interior have likewise been productive of important results. The numerous correspondents of the Smithsonian Institution, both in the boreal and in the tropical portions of the continent, though not always citizens of the United States, have added greatly to our store of ornithological material and knowledge. The several naval exploring expeditions have also contributed, from distant foreign shores, rich stores of specimens and facts. Among more private enterprises should not be forgotten the Thayer and Hassler expeditions from the Museum of Comparative Zoölogy to South America, both of which returned with rich ornithological collections, numbering in the aggregate thousands of specimens. The expeditions of Professor Orton, Mr. Alexander Agassiz, and Mr. Linden have also been fruitful in ornithological results. Of the explorations of Dr. Bryant in the West Indies, and of numerous other ornithological explorers elsewhere, the want of space forbids a further notice.

SUMMARY OF PROGRESS.

When Alexander Wilson, the "Father of American Ornithology," began his great work, less than three fourths of a century ago, probably not a dozen species of American birds had been scientifically described by American writers, and almost nothing had been published relating to their distribution or habits. On the completion of Bonaparte's continuation of Wilson's work in 1833, about four hundred species had been described by these two authors, of which colored figures had also been published, with a more or less full account of the habits and range of each species. In 1833, Bonaparte (in his Geographical and Comparative List) gave the number of North American species as four hundred and seventy-one, while in 1839 the number described by Audubon (in his Synopsis) was four hundred and ninety-one. Nearly all of these had been re-figured by Audubon, the figures being all of life size, and as yet unsurpassed in fidelity or artistic effect. Audubon had likewise largely increased our knowledge of their distribution and habits, while the greater part had, moreover, found a valuable biographer in Thomas Nuttall. The publication of numerous minor papers had also contributed largely to a better knowledge of many of the species.

In 1844 the number of species had increased to five hundred and six, the number given by Audubon in his Birds of North America. In 1858 the number had risen to seven hundred and sixteen, all of which had been ably elaborated by the authors of the General Report, their affinities thoroughly discussed, and their nomenclature carefully revised. In the mean time numerous special papers had appeared relating to their habits and distribution. Yet the nests and eggs, and even the winter and summer resorts, of many of the species still remained unknown.

From this time onward information respecting our birds increased more rapidly than before; new workers came prominently into the field, and a rapid advance marked every year. At the present time the number of generally accepted species entitled to recognition as birds of that portion of North America north of Mexico is not less than six hundred and fifty, with, in addition, about one hundred and fifty commonly recognized subspecies, or about eight hundred recognized forms. The nests, eggs, and general habits of nearly all are now well known, particularly of those which occur east of the Rocky Mountains. Among the recently discovered extinct species have been found entirely new types representing what is believed to be a new sub-class, they having true teeth and other characters assimilating them to reptiles, between which and true birds they undoubtedly form connecting links.

Another phase of progress that should not pass unnoticed in this connection is the attention that has been paid to the geographical distribution of the species, with especial reference to the determination of the different faunal areas in North America, many of which are already known with a tolerable degree of definiteness; also the tendency to study the various sub-specific and specific forms from a geographical and evolutionary standpoint. Formerly the study of our birds was pursued wholly analytically, and forms from distant, little-known localities which differed slightly from their near affines of neighboring regions were looked upon as distinct "species." Later, as the material for a better knowledge of the subject accumulated, specimens of an intermediate character came to light, which, so long as they were few, were naturally looked upon as probably hybrids between the forms whose characters they seemed to combine. Still later, however, it was found that certain strains of deviation from pronounced types occurred in a large number of species belonging to widely different families inhabiting the same areas. This led to the discovery of laws of geographical variation, connecting particular phases of local differentiation with the topographical and climatic peculiarities of the regions where they so uniformly occur. Many of the isolated facts bearing on this subject had been observed and placed on record prior even to 1860, but their full import was not realized till after the lapse of another decade, during which our stores of material had become vastly increased. In 1871 the "new departure" was for the first time fairly entered upon, which in three years revolutionized the nomenclature of North American ornithology, adding an important chapter to philosophical zoölogy, and exerting great influence in many other departments of North American zoölogy. Naturally, a view that threatened either to assign fully one sixth of the previously recognized species to the limbos of synonomy or to lower them to the grade of geographical races was not rashly espoused by those to whom belonged the credit of the recognition and description of these previously supposed specific forms; but so overwhelming were the facts in its favor found to be, that one after another of our leading writers soon gave it their indorsement, so that probably a greater degree of unanimity of opinion respecting any problems in ornithology never obtained, than now exists among our ornithologists respecting the subject of geographical variation among our birds and the sub-specific relationship of many forms which when first made known seemed unquestionably of specific rank.

The next step, and apparently a wholly logical one in the revolution, will doubtless be the general adoption of a trinomial system of nomenclature for the more convenient expression of the relationship of what are conventionally termed "sub-species," so that we may write, for instance, *Falco communis anatum* in place of the more cumbersome *Falco communis* subsp. *anatum*. This system is already, in fact, to some extent in use here, though looked upon with strong disfavor by our transatlantic fellow-workers, who seem as yet not fully to understand the nature of the recent rapid advance ornithology has made in this country, or to appreciate the thoroughly substantial nature of the evidence on which it is based. The constant and energetic exploration of the great North and Northwest, of the vast trans-Mississippian region, and of our sub-tropical borders, during the last two decades, by scores of indefatigable collectors and observers, has certainly not been in vain, as witness the hundreds and often thousands of specimens of single species, representing the gradually varying phases presented at hundreds of localities, that have passed through the hands of our specialists.

While the field of North American ornithology is far from an exhausted one, the progress made during little more than a half century is certainly creditable to American enterprise and to American students, though to Americans alone, of course, belongs only a share of the credit of the marked advancement.

In a short article like the present, devoted exclusively to what Americans have accomplished, justice can hardly be done to all, nor is there room to more than allude to the fact that much has been done in aid of the general advance by numerous foreign writers. By no means have all the names of even Americans that are deserving of recognition here, been mentioned in the present article, nor have all articles been cited that are entitled to a high degree of prominence; the omissions, however, are those of limitation and not of choice. Neither is there space to notice the several important ornithological collections that have been gathered, to which alone many pages might be profitably devoted.

RECENT LITERATURE.

ORTON'S COMPARATIVE ZOÖLOGY.[1] — The plan of this book is excellent, and the distribution of the various subjects well carried out. The first half of the book is devoted to comparative anatomy and physiology, containing chapters with titles such as these: Plants and Animals distinguished, Life, Organization, The Food of Animals, How Animals eat, How Animals breathe, Secretion and Excretion, How Animals move, The Nervous System. Development. This portion of the work is more carefully prepared than the second, on classification. Now and then, but not often, we notice a slip of the pen, as "structureless sponge," whereas the sponge is a many-celled animal, with ciliated epithelium, and producing eggs and spermatic particles. On page 164 the figure of the nervous system of a starfish will scarcely do, as in nature but a single nerve is sent to each ray, and the ganglia are not at all as represented by the artist. In the section on instinct and intelligence, which in the main is excellent, the author remarks of the bee, "We do not find one clever and another stupid." We had supposed that observers had noticed a marked individuality among bees and other social insects. As regards the beaver (see page 184), Mr. Morgan has well shown that it acts by reason as well as instinctively. "The egg" of the Amœba is spoken of on page 191, though no rhizopods are known to reproduce by eggs; for this reason the statement on page 188, that "all animals, without exception, arise from eggs," should be modified, as there are whole orders of Protozoa which do not produce eggs. On page 201 it is said that the "grand characteristic" of the vertebrate embryo is the primitive stripe, "which does not exist in the egg of any invertebrate.'' It is known to exist in the eggs of the leech, earthworm, and allied forms, and with very rare exceptions in the eggs of all insects yet observed. Still this portion of the work is well written, in a clear, lively, and attractive style, and the book is certainly nowhere dull reading.

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[1] *Comparative Zoölogy, Structural and Systematic.* For Use in Schools and Colleges. By JAMES ORTON, A. M. New York: Harper and Brothers. 1876. 12mo, pp. 396.

In some respects we are disposed to find fault with the portion on classification, though on these points naturalists are of many minds. Certainly the many-celled sponges do not belong with the Protozoa, nor are they compound Amœbæ. The Gregarinæ are not "the simplest animal forms of which we have any knowledge," though the author rejects the *Monera* of Haeckel. The Polyzoa, Brachiopods, and Tunicata are retained among the Mollusca, and in fact the classification is not to our mind so advanced in its treatment as other parts of the work. The old division of *Entomostraca* is retained, though Limulus represents quite a different division of Crustacea. On page 276 the lobster, represented by a time-honored English cut, is called *Astacus marinus.* The Arachnida are by the author provided with "antennæ," though they do not exist in nature. Much space is devoted to the vertebrates, as seems necessary in such a book as this, which has many useful features about it adapting it for use in schools. The three hundred and fifty wood-cuts are in almost every case, we should judge, borrowed from other works, and a larger number represent European animals than is suitable in a book designed for use by American youth.

Recent Books and Pamphlets. — Practical Botany, Structural and Systematic, the latter Portion being an Analytical Key to the Wild Flowering Plants, Trees, Shrubs, Ordinary Herbs, Sedges, and Grasses of the Northern and Middle United States east of the Mississippi. By August Kœhler. Copiously Illustrated. New York: Henry Holt & Co. 1876. 12mo, pp. 400. $3.00.

The Andes and the Amazon; or, Across the Continent of South America. By James Orton, A. M. Third edition, revised and enlarged, containing Notes of a Second Journey across the Continent from Para to Lima and Lake Titicaca. With two Maps and numerous Illustrations. New York: Harper & Brothers. 1876. 12mo, pp. 645.

Sexual, Individual, and Geographical Variation in *Leucosticte tephrocotis*. Geographical Variation among North American Mammals, especially in Respect to Size. By J. A. Allen. (Extracted from Bulletin of the Geological and Geographical Survey of the Territories, vol. ii., No. 4.) Washington, July 1, 1876. 8vo, pp. 30.

Notes on the Geology of Northeastern New Mexico. By O. St. John. (Extracted from the Bulletin of the Geological and Geographical Survey of the Territories, vol. ii., No. 4.) Washington, July 1, 1876. 8vo, pp. 280–308.

Archivos do Museu Nacional do Rio de Janeiro. Vol. i., 1 Trimestre. Rio de Janeiro. 1876. 4to, pp. 30.

The Oaks of the United States. By Dr. G. Engelmann. (From the Transactions of the Academy of Science of St. Louis, vol. iii.) St. Louis, Mo. 1876. 8vo, pp. 20.

Notes on Agave. By Geo. Engelmann, M. D. (From the Transactions of the Academy of Science, of St Louis, vol. iii.) St. Louis, Mo. 1875. 8vo, pp. 35.

The Forest. Products of Michigan at the Centennial Exposition. By Prof. W. J. Beal. Lansing, Mich. 8vo, pp. 16.

Micro-Photographs in Histology, Normal and Pathological. By Carl Seiler, M. D., in conjunction with J. Gibbons Hunt, M. D., and J. G. Richardson, M. D. Vol. i., Nos. 1, 2. Philadelphia: J. H. Coates & Co. 4to, 8 Plates.

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GENERAL NOTES.

BOTANY.[1]

SCHŒNOLIRION; APPENDIX. — About the time when my little article on *Schœnolirion*, for our July number, was issued, a valued Californian correspondent, Mrs. R. M. Austin, rediscovered the doubtful species referred to, namely, *S. album* of Durand, and sent me specimens which have just come to hand. Pratten's specimen, the only one before known, consisted merely of the top of a scape, with the raceme. I have not seen it, and it is probably in Durand's herbarium, at the *Jardin des Plantes*, Paris. But Dr. Torrey's remarks leave no doubt as to the identification, and the specimens (now complete, except as to the fruit.) justify his reference of the plant to his genus *Schœnolirion*. Nevertheless it differs somewhat from the Atlantic species in the particulars mentioned by Dr. Torrey, and especially in the texture of the dried perianth, which is scarious, in the manner of *Allium*. Moreover, only its outer divisions answer to the description as to the three "almost confluent nerves," the three inner divisions being strictly one-nerved. Besides, the ovary is short-stipitate. The ovules in this and the original species of Michaux are geminate and ascending, not "horizontal." The diagnosis of this fourth species may accordingly be expressed as follows: —

S. ALBUM Durand. Leaves rather flaccid; flowers very numerous in a virgate raceme: pedicels horizontal, shorter than the bracts or the perianth: the latter bright, white, scarious when dry; the divisions nerveless, except the midrib, which is triple in the three outer, but simple in the inner: filaments subulate, decidedly perigynous: ovary short-stipitate. California, in Nevada County, *Mr. Pratten;* Plumas County, *Mrs. R. M. Austin.*

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[1] Conducted by PROF. G. L. GOODALE.

It may now be added that the character "rhizomate bulboso-tuberosa," by Dr. Torrey, is by no means correct, and the "root a tuberous rhizoma," of Dr. Chapman, is still less applicable to any species except *S. Elliottii*, and not perhaps properly to that. *S. croceum* and *S. Texanum* have a small but distinct tunicated bulb, the coats fleshy and not numerous, and from the base of this apparently a fusiform root proceeds. *S. album* shows a similar bulb, from the corner of which beneath springs a cluster of rootlets. Our specimens of *S. Elliottii*, all from Dr. Chapman, are indeed destitute of bulb, and show something like a rhizoma. Good specimens showing the underground growth of all these plants are now much wanted.

S. Elliottii not rarely branches its raceme into a panicle. This genus, therefore, presents two difficulties in the way of Mr. Baker's new arrangement of the Liliaceous tribes. It seems to me not remotely related to *Nolina;* but the pedicels are always solitary. — A. GRAY.

SEDUM REFLEXUM L. — This Old World *Sedum*, which is occasionally met with in old-fashioned gardens, has established itself at Pigeon Cove, Essex County, Mass., as we learn from Mrs. Alonzo Wheeler, who has sent living specimens. It occupies an old stone-heap, in a patch a yard or two in diameter, where "Mrs. Sarah Ann Colburn says she noticed it when she was a very little girl, at least sixty years ago," and whence she transplanted some of it to the cemetery at Folly Cove, thirteen years ago. As the station of the plant is only a few rods distant from the ancient dwelling known as "the Garrison House" (a view of which in a wood-cut adorns the twenty-first page of Mr. Leonard's Pigeon Cove and Vicinity), we cannot doubt that it is an escape from gardens, although the species is not handsome enough to reward cultivation, The plants still carry some marks of former cultivation: first, in the augmentation of the normal number of parts in the blossom. Instead of five in the calyx and corolla, or even six, which is not rare in the wild plant in Europe, there are mostly from seven to nine or ten, so that the plant assumes the technical character of *Sempervivum*. Secondly, these flowers are apt to run together into a sort of crest, and to make a somewhat fasciated inflorescence, or a dense cluster, from which, later, pedicels spring in a proliferous manner. We do not wonder that Mrs. Wheeler was puzzled with it. Still she divined that it was some vagarious *Sedum*, not in the ordinary books. — A. GRAY.

A NEW FIR OF THE ROCKY MOUNTAINS. — While collecting in the Wasatch Mountains, in Eastern Utah, last summer, for Major Powell's Survey of the Colorado, I obtained five species of fir, two of which possess a special interest, growing out of the confusion which has heretofore existed respecting the group to which they belong, and the fact that one of them bids fair to be established as a new species. The other turns out to be *Abies concolor* Eng., and not *A. grandis* Lindl., as was supposed, and under which name this tree has been several times reported.

The leaves of my specimens are not glaucous above, but underneath only or not at all, this character not being a constant one. This tree is there known to the Mormon lumbermen as "black balsam" and makes an excellent quality of lumber. It is rarely found above 8500 feet altitude, or below 7000 feet.

But there was another tree there, very much resembling this in its botanical characters, though differing widely in other respects, which I well knew to be a different thing, and as it answered to no description I could find, I became deeply interested in it. In altitude it commences just where the other leaves off, and continues on up nearly to the timber line, or over 11,000 feet altitude. I found it both in the basin of the Sevier River, above Gunnison, and also far to the eastward across the divide on the Colorado side, high up on the slopes of Aquarius Plateau and Thousand Lake Mountain. This tree is distinguished by the lumbermen of that region as "white balsam." It is also known as "pumpkin pine," the wood being rather spongy and poor for lumber. But otherwise it is a much finer tree than *A. concolor,* being very tall and straight, with few limbs from its lower trunk. Of both species I brought back specimens, not only of the leaves, cones, etc., but also sections of the trunk for exhibition at the Centennial, where they may now be seen in Dr. Vasey's excellent collection sent from the Department of Agriculture. I also sent specimens to Dr. Engelmann for identification, from whose report, as follows, it appears that both the species above mentioned have been heretofore confounded under the name of *A. grandis* Lindl., inapplicable to either.

"*Abies subalpina* is the provisional name Dr. Engelmann gives to that fir which occupies the highest wooded regions up to the limits of vegetation in the Rocky Mountains, from Colorado northward and westward to Oregon. In lower altitudes it is replaced in Colorado and Utah by *A. concolor*, and in Oregon by *A. grandis.* All the specimens sent from Colorado by Parry, Hall, and others belong here; but in Oregon collections it is mixed with *A. grandis,* and in both regions has been designated by this latter name. Its nearest affinity is not to any western *Abies,* but to the eastern *A. balsamea,* of which it may prove a geographical variety. Its leaves are shorter than those of *A. grandis,* those of the lower sterile branches are slightly emarginate, on the upper side grooved and without stomata. The leaves of vigorous shoots and of cone-bearing branchlets are acute, above convex and provided with stomata. The cones are purplish brown, the scales scarcely wider than long; the bracts are variable in this as in most other species, and not of much diagnostic value. Mr. A. Murray has, in an Oregon specimen collected by Dr. Lyall, noticed this difference of leaves of sterile and fertile branches, and therefore named it *A. bifolia;* this, however, is a misnomer, indicating something very different from what he intended, and cannot stand.

"In a paper shortly to be published in the Transactions of the St. Louis

Academy of Science, Dr. Engelmann has gone more extensively into the different questions relating to the North American species of Abies."

Until this very needful revision appears, the following characters, drawn from my own specimens, may serve to designate more particularly our welcome newcomer from the mountains.

Abies subalpina Eng., n. sp. Tall and slim, 80 to 100 feet high, often 50 feet without branches; bark smooth, white, and covered with vesicles to near the base; leaves 6 to 12 lines long, less than a line broad, not twisted near the base, bisulcate and somewhat glaucous on the lower (outer) side, short-pointed, obtuse or slightly emarginate, those on the lower branches 2-ranked and spreading, those on the upper scattered, crowded, and more or less appressed, shorter on fertile than on sterile branchlets; cones 2½ to 3 inches long, 1½ to 2 inches thick, solitary, erect, ovate or oblong, obtuse, greenish; scales 6 to 10 lines long and about as broad, horizontal and close-pressed, broad-cuneate, unguiculate, the rounded upper margin somewhat reflexed and resinous, pubescent; bracts short, white with a dark base, erose-dentate all round, their slightly elevated summits furnished with a strong mucro; seeds large, the wing covering nearly the whole surface of the scale; sterile aments 2 inches long, 3 lines in diameter, marked longitudinally and somewhat spirally by the dark centres of the otherwise light brown mucronate scales. — LESTER F. WARD.

BOTANICAL PAPERS IN RECENT PERIODICALS. — *Flora*, Nos. 16 and 17. J. Sachs, On Emulsion Figures, and Clustering of Swarm Spores in Water (continued in No. 17, and not yet finished). A. de Krempelhuber, Brazilian Lichens. Worthington Smith, The Resting Spores of Peronospora infestans. No other journals have come to hand at this date.

ZOÖLOGY.

HABITS OF THE WHITE-FOOTED MOUSE. — The white-footed mouse (*Mus leucopus*) sometimes takes up its abode in deserted bird's-nests Audubon, in his work on the Quadrupeds of North America, speaks of this peculiar habit. He says it has been known to take possession of deserted bird's-nests, such as those of the cat-bird, red-winged starling, song-thrush, and red-eyed flycatcher. One day toward the end of August, 1875, I found one of these mice in the deserted nest of a red-eyed flycatcher (*Vireo olivaceus*); it was on the border of a thick forest in the Blueridge Mountains, Monroe County, Pa. The nest was situated near the extremity of one of the limbs of a sapling or young tree, a few feet from the ground. The mouse had completely stopped up the inside of the nest with dried grass, leaving just enough room to squeeze itself through, and have a comfortable bed at the bottom. It was inside of the nest when I found it, but afterwards escaped. When I first observed this peculiar structure I could not make out what it was; but on thrusting my finger through the dried grass, I discovered the strange tenant.

It moved off, after getting out of the nest, in a rather sluggish manner, as this species is nocturnal and sleeps during the day. — SPENCER TROTTER.

THE BLUEBIRD FEEDING ON AMPELOPSIS. — On the 2d of April, 1876, this city was visited by remarkably large numbers of the bluebird (*Sialia sialis* Baird). This was its first appearance in abundance this season, only a few stray individuals having previously paid us a " flying visit," during the wonderful installment of warm weather with which we were favored in January. The day was cold, and the frozen ground was partially covered with snow, the remains of the heavy fall of a few days before. Awakened before six o'clock in the morning by the loud twitterings of the birds, I found my visitors busily devouring the berries of the Virginian creeper (*Ampelopsis quinquefolia* Michx.), the vines of which extend over the whole of the easterly side of my house. They having been uncommonly prolific the past season, the branches were thickly covered with clusters of the purple fruit, which adhered to the stems all through the winter. From morning till night the bluebirds, continuing to arrive, crowded the vines, voraciously eating the berries, of which, in their eagerness, they broke off nearly as many as they swallowed. The next day the weather suddenly became milder, and the birds disappeared. — HENRY GILLMAN, Detroit, Mich.

ANTHROPOLOGY.

ANTHROPOLOGICAL NEWS. — In the third volume of the Transactions of the Academy of Sciences of St. Louis, Mr. A. J. Conant has published an article upon the archæology of Missouri, especially the caves of the Ozark Mountains and the mounds and earthworks on the banks of Bayou St. John, in the southeastern portion of the State.

The *New York Tribune* of July 7th records the tragic death of L. H. Cheney, a member of the Harvard Summer School of Geology, at Cumberland Gap. While excavating a mound with three others, he was buried by the falling earth. His companions were saved.

The State Archæological Association of Indiana will hold its first annual meeting in the rooms of the state geologist at Indianapolis, on the 17th and 18th of October. In addition to the regular sessions, excursions will be made to interesting localities. Provisions are also on foot to establish a museum and library. We heartily commend this scheme, and believe that exhaustive special collections are necessary to supplement the National and the Peabody Museums.

The *North American Review* for July contains Mr. Lewis H. Morgan's paper, read before the last meeting of the National Academy on the Houses of the Mound Builders. The distinguished author believes that the mural mounds were the foundations of the communal dwellings of village Indians, and that they can be understood by the study of similar structures now existing or known to have existed since the commencement of American exploration.

The Proceedings of the American Association for 1875 has appeared, and contains full reports or extended abstracts of C. V. Riley's paper on Locusts as Food for Man, Whittlesey's paper on Ancient Rock Inscriptions in Ohio, Morgan's paper on Ethnical Periods and on Arts of Subsistence, Sternberg's paper on Indian Burial Mounds and Shell-Heaps near Pensacola, Comstock's Archæological Notes from Wyoming, Coffinberry and Strong's paper on the Explorations of Ancient Mounds in the Vicinity of Grand Rapids, Michigan, Farquharson's paper on Recent Exploration of Mounds near Davenport, Iowa, and Gilman's paper on the Ancient Men of the Great Lakes. Several other papers are mentioned by title, but no abstracts are given.

The Society of Anthropology of Paris has offered a prize this year to be presented to the author of the best paper upon the subject, The Slavonic Races, and Maps of the Countries inhabited by the Slavonians.

The *Athenæum* for July 8th contains the remainder of the questions to be discussed at the International Congress of Orientalists at St. Petersburg. They relate to Turanian, Japanese, Indian, Arabian, Persian, and Hebrew investigations.

Professor Busk exhibited to the London Anthropological Institute, June 13th, a collection of skulls from the New Hebrides. Some of those from Mallicolo showed flattening of the forehead.

The first seven articles of the Transactions of the New Zealand Institute for 1875 relate to the Maori race, Moas and Moa-Hunters, and the relation between the Maoris and the Moa-Hunters. The tendency seems to be to discard the notions of Haast and others that the Moa became extinct many centuries ago, and that the Moa-Hunters were a prehistoric people, now quite extinct, and not at all related to the Maoris.

A paper by Mr. Rankin on The South Sea Islanders was read by Mr. Brabrook before the Anthropological Institute, June 13th, in which the title Mahori is proposed for the light-colored races of the Pacific Isles, and Papuan for the blacks. The author believes that the latter first peopled the greater part of the islands, and that the lighter race, coming later from the west, settled first in Samoa, and spread thence in all directions, mingling often with the Papuans. He showed several differences between the Maoris and the Malays, who seem to be a separate race.

In *Nature* for June 29th, the Rev. J. S. Whitmee makes some very sound observations upon the errors which have been propagated with reference to the supposed rapid decrease of the Polynesians, and the same may apply to aborigines in general. The first source of error is the excessively high estimates put upon these countries by early visitors, who assumed the thickly settled strips of coast which they explored as a sample of the whole country. In many islands, the author believes, the population is actually increasing, owing to the beneficial influence of the missionaries, the cessation of human sacrifice, cannibalism, and infanticide, the fewer wars, the better treatment of women, the care of children, the sick, and the aged, and a more steady supply of food. Upon these topics the author has collected a great many statistics.

The second number of Broca's *Revue d'Anthropologie* for 1876 is at hand, and contains the following matter: Upon Cranio-Cerebral Topography, Broca; Banton or Abanton, Hovelacque; Vanikoro and its Inhabitants, Lesson; The Tumulus of Eshoj, Denmark, Engelhardt; Revue critique, Revue préhistorique, Revue des Livres, Revue des Journaux, Extraits et Analyses, Miscellanea, Nécrologie, Bulletin bibliographique. Nearly one half the number is taken up with the treatment of cranio-cerebral topography by M. Broca, and the review of the most eminent works which have been published upon the subject by Gratiolet, Arnold, Broca, Bischoff, Heftler, Turner, Féré, Ecker, and Landzert.

Das Ausland, under the editorship of F. von Hellwald, always contains some interesting anthropological description or discussion. In the number for May 29th is a review of Rutimeyer's Variation of the Fauna of Switzerland since the Existence of Man there, also a *résumé* of the Indian Tribes of the United States made from Authentic Sources, by Adolph Hunnius; in the number for June 5th, Dr. Bela Weisz discusses Œconomics; in that for June 12th, the Earliest Use of Potstone (Lapis ollaris), and in that for June 19th, the Origin of Alphabetic Writing, the Numerical Relations of the Sexes, and Manners and Customs in Servia are discussed. — O. T. MASON.

OCCURRENCE OF THE PATOO-PATOO IN NORTH AMERICA. — An interesting example of the independent production of a well-known foreign form of weapons may be seen in the Michigan exhibit of stone and copper implements at the Philadelphia Exposition, where there is a single specimen of steatite patoo-patoo, such as is common in New Zealand. These weapons are described by Tylor (Early History of Mankind, p. 204, London, 1870) as "an edged club of bone or stone, which has been compared to a beaver's tail, or is still more like a soda-water bottle with the bulb flattened, and it is a very effective weapon in a hand-to-hand fight, being so sharp that a man's skull may be split at one blow with it." This description will strictly apply to the Michigan specimen, with the one exception of not being drilled at the smaller end, for a wrist cord. This weapon measures sixteen and one fourth inches in length. It is two and five eighths inches wide for eleven inches, when it tapers to one and one half inches, but again widens to two inches at the end, thus forming a terminal knob or button, about which a wrist cord could be securely fastened. The edges are beautifully wrought and are as sharp now as the general find of polished stone axes and celts. E. B. Tylor, whom we have already quoted, mentions the occurrence of such a specimen, "of dark brown jasper," from Peru, and also one, "of a greenish amphibolic stone," from Cuzco, which is figured by Rivero and Tschudi. Of the vast numbers of relics of American aborigines at Philadelphia there is no other specimen of the form above described, and it is presumable that this weapon was one seldom fashioned in North America, and its occurrence seems better explained by considering it rather as an independent invention of its original owner, than a copy of the favorite arm of another people. — C. C. ABBOTT, M. D.

GEOLOGY AND PALÆONTOLOGY.

ICEBERGS OFF THE COAST OF NEWFOUNDLAND. — On the coast of Newfoundland, icebergs generally make their appearance about the 1st of January. Their approach is heralded by a number of smaller pieces. When we reflect upon the origin of these bergs, it would appear that the greater number of them ought to be disengaged from their parent mass, the glacier, in summer-time. The semi-fluid mass of which the glacier is made up, creeping slowly, like a frozen river, down the valley, by the aid of heat, gravity, etc., has in summer-time its pace augmented by the increment it receives at this season of the year. It then pushes itself rapidly forward into the ocean, and there, by the buoyancy of the water, the projecting ice-mass is detached and floated off. Why, therefore, is it that the bergs are not seen off the coast of Newfoundland at the close of the summer, or at latest in the "fall" of the year? The answer to this may be obtained from the inference of Sir Edward Belcher and other arctic navigators, who tell us that in very high latitudes the ice appears to be in motion much earlier than it is farther to the south. On the 20th of May the western side of Smith's Sound has been found to be quite open for navigators in a boat, whilst Barron Strait is not navigable till late in August. The consequence of this would appear to be that whatever ice may be set free far north early in the year is detained in more southern latitudes until the fall. Another cause also operating in keeping the ice off the coast until the spring of the year may be the wind. Although icebergs, with regard to their motion and the direction of the wind, often present curious anomalies, yet these must to a slight degree be influential on their wanderings. In the fall of the year the prevalent winds on the North American side of the Atlantic are, generally speaking, from the west, which tend to keep all bergs out at sea, and thus to observers on the land they would be lost sight of; but in the spring of the year the winds are more or less northerly. which would only aid the current in bringing the ice along shore. The most apparent suggestion for the detention of the ice before reaching the shores of Labrador and Newfoundland is of course the distance it has to travel; but considering the steady rate at which this is carried on in the stream which bears it, the effects of wind and the delay in the breaking up of the southern arctic barrier must have the precedence. — *J. Milne in the Geological Magazine, July.*

RECENT VIEWS IN GEOLOGY. — Mr. John Evans, in his late address as president of the Geological Society of London, after giving obituary notices of Sir Charles Lyell, Mr. Scrope, Deshayes, and others, discusses recent phases of geological thought, and after speaking of the bearings of solar physics on the early history of our planet, refers to the glacial epoch, for the production of which he insists on a change in the geographical position of the earth's axis, and claims that it is premature to invoke intense glacial periods to account for all the glacial phenomena which may be observed. "Much as we must esteem the labors of M. Ahémar and Mr. Croll, and others who have gone so deeply into the question of glaciation, — enormous as have been the effects of ice in this and other countries, — there are many who cannot but feel that the ice-caps invoked almost transcend our powers of belief, and who will be grateful to any astronomer or mathematician who will bring the pole round which they were generated somewhat nearer to our doors."

He prophesies that "the great work of future palæontologists will rather lie in still further developing the affinities of genera, than in merely recording the minute distinctions of species. The discoveries which have of late been made have a tendency to fill in the missing links in the chain of organic nature, and to lead to the adoption of some form of that great doctrine of evolution which has received so large an amount of support from a former occupant of this chair, to whom we have this day presented the Wollaston Medal, Professor Huxley. It is highly probable that much more will be done in the same direction. In addition to what has been effected by Mons. Albert Gaudry in his researches on the fossils of Pikermi and Mont Léberon, and by Dr. W. Kowalevsky in his investigations of the osteology of the Hyopotamidæ, the discoveries of Professors Marsh and Leidy in America are doing much toward illustrating the line of descent of many of the higher mammalia."

A CARNIVOROUS REPTILE ABOUT THE SIZE OF A LION. — Professor Owen describes and figures in the *Quarterly Journal of the Geological Society*, the remains of a carnivorous reptile from the Karoo Lake deposits of South Africa. It is called *Cynodraco major*, and for this type, with a number of other extinct carnivorous saurians, he forms a distinct order of reptiles under the name *Theriodontia.* In concluding his paper, Professor Owen inquires whether the transference of structures from the reptilian to the mammalian type has been "a seeming one, delusive, due to accidental coincidence in animal species independently (thaumatogenously) created, or was the transference real, consequent on nomogeny or the incoming of species by secondary law, the mode of operation of which we have still to learn? Certain it is that the lost reptilian structures dealt with in the present paper are now manifested by quadrupeds with a higher condition of cerebral, circulatory, respiratory and tegumentary systems, the acquisition of which is not intelligible to the writer on either the Lamarckian or the Darwinian hypothesis."

GEOLOGICAL SURVEY OF CANADA. — The Report of Progress for 1874–75, besides the introductory report by Mr. Selwyn, the director of the survey, contains reports on the country west of lakes Manitoba and Winnipegosis, with notes on the geology of Lake Winnepeg, by Mr. Robert Bell; a report on the country between the Upper Assineboine River and lakes Winnipegosis and Manitoba, by Mr. J. W. Spencer; a report of much general interest on explorations in British Columbia, by Mr. James Richardson; and a report on geological observations in New Brunswick in 1874, by Prof. L. W. Bailey and Mr. G. F. Matthew. Other reports of economic interest follow. The staff of the director consists of ten geological explorers, and the total annual appropriation for this important survey is only $45,000, "a sum not greater than is granted for similar purposes by many single States in the neighboring Union."

THE WALRUS FORMERLY IN SOUTH CAROLINA. — In a collection of fossil bones from the Ashley phosphate beds near Charleston, S. C., Dr. Leidy identifies a complete tusk of the walrus, indicating a still farther point south for the extension of this animal than had been previously known, Virginia (at least Martha's Vineyard) having been, we believe, the farthest point southward where it had previously been found. Associated with this tusk were the skull of a manatee, a tooth of the Megatherium, and the bones of a number of new species of cetaceans, among them a huge tooth of a form allied to the sperm whale, and probably the same as those from the Crag formation of Antwerp, ascribed to Dinoziphius.

MORE FOSSIL BIRDS. — The bones of two species of a bird like the diver, and also with affinities to Professor Marsh's cretaceous genus *Hesperornis*, have been discovered by Professor Seeley in the chalk formation of England.

GEOGRAPHY AND EXPLORATION.

NEWS FROM STANLEY. — This enterprising explorer, after a long silence, during which much anxiety had been felt about him, writes from the district of Ujiji on Lake Tanganyika. The letters received and published in the *New York Herald*, are five in number, and contain a narrative of Stanley's voyages, land journeys, and adventures from June, 1875, when he was last heard from, to April 26, 1876, when he was within fifteen days' march of Ujiji. The first, written July 29, 1875, gives an account of his voyage from M'tesa's capital to his camp at the southern end of Victoria Lake, near the Shimeeyu River. He not only encountered violent and dangerous storms, but he and his party narrowly escaped massacre at the hands of the savage natives of Bumbireh, a large island on the western side of the lake. The second letter, written seventeen days later, describes his return, with his whole party, to Uganda (M'tesa's kingdom), and the punishment inflicted on the savages of Bumbireh by the way. An interval of five months elapsed before his third letter was written. During this period, by the friendly aid of

M'tesa, who furnished him with a large escort of Uganda spearmen, he crossed the country to the Albert Lake, traversing the lofty, mountainous region of Gambaragara, which was only seen by Speke in the distance. The latter estimated the altitude of the highest peak at ten thousand feet above the sea; but Stanley scaled the highlands dividing the two great lakes, and there discovered a new tribe of natives, of whom we only learn as yet that they are "pale-faced." This expression must not be taken too literally, yet the discovery is of very great interest in an ethnological point of view.

No dates are given of this journey, but Stanley appears to have reached the Albert Lake in December last. He encamped on a large bay or inlet, to which he gave the name of the Princess Beatrice, and after a short stay returned to Uganda without having made any navigation of the lake. This fact probably explains why M. Gessi, in April of this year, failed to obtain any news of Stanley's visit. The letter describing the journey was dated from Kawanga, near M'tesa's capital, on the 18th of January last. The next news is from Kaufurra, a point not yet located on the maps, March 26th. It is probably somewhere in the dominions of King Rumanika, who showed such favor to Speke and Grant, for Stanley speaks of having explored the Kageera River, a western tributary of the Victoria, the lake called Windermere by Speke, and the hot springs of Karagwe. The fifth and last letter was written on the 24th of April, in the now familiar region of Unyamwezi, and within easy reach of the little port of Ujiji, on Lake Tanganyika, where Stanley met Livingstone. His intention was to reach the northern extremity of the lake, and then cross to the southern end of the Albert Nyanza, thereby definitely settling another important geographical question. He was in good health, and still amply provided with men and supplies. — *New York Tribune.*

CIRCUMNAVIGATION OF LAKE ALBERT NYANZA. — At a late meeting of the Royal Geographical Society, a letter from General Stone, on The Circumnavigation of the Lake Albert Nyanza, by M. Gessi, was read. The points of importance in M. Gessi's paper were that Lake Albert Nyanza is one hundred and forty miles long and fifty broad, and that in the east there is a river flowing into the lake which is now confidently believed to be one of the sources of the Nile. This, Sir R. Alcock said, was a most important result of M. Gessi's expedition, as it made it quite clear that the White Nile issued from the Lake Albert Nyanza. Sir Samuel Baker had written to him (Sir. R. Alcock) indorsing the importance of M. Gessi's discoveries, which had established a fact that for eighteen centuries had baffled all the geographers of the world.

MICROSCOPY.[1]

Recognition of Wool in Mixed Fabrics. — Any child at all familiar with the instrument can instantly distinguish wool from cotton, linen, and silk, as figured in the common books on the microscope; but the exigencies of modern commerce have developed new and difficult questions in regard to the diagnosis of wool. The Treasury Department of the United States, after having from June, 1870, down to February, 1875, admitted certain fabrics, known as "calf-hair goods," free from those duties which would be levied upon goods composed in part of woolen fibres, on certificate from the manufacturers of such articles that they were made entirely of cow-hair, calf-hair, and vegetable fibres, and contained no wool or worsted in any form, became possessed of strong evidence that these fabrics were not made, and could not be made, wholly without wool, and submitted the question to the National Academy of Sciences for investigation, furnishing more than ninety samples of these goods as materials for study. Drs. J. J. Woodward and J. L. Leconte were appointed a commission to investigate the subject, and at their request Drs. J. G. Hunt and E. M. Schaeffer made a careful microscopical examination of the samples furnished, and also, for comparison, of different varieties of commercial wool and of hair from different animals, and prepared mounted samples of each for further study and comparison. The fibres, having been rendered opaque by the dyestuffs previously employed, were bleached in dilute mineral acids, mounted in glycerine, and examined mostly with powers of from ½ to ⅛ inch, except for estimating percentages, for which lower powers were employed. In a few of the samples submitted no wool was found, or only doubtful hairs, or a few fibres, not certainly indicating an intentional admixture. In a larger proportion of cases there was not much wool, while in a very large number of samples there was from five and ten per cent. to a much larger proportion; in one case it being difficult to find five per cent. of genuine cow-hair.

As a result of these observations, and of a subsequent verification of them, the commission submitted to the Secretary of the Treasury a report which contributes largely to the clearness of our knowledge of the relations of wool to other kinds of hair, and which is published, with excellent heliotype illustrations, in the Bulletin of the National Association of Wool Manufacturers, December, 1875.

While it is remembered that some microscopists deny the possibility of distinguishing the hair of the cow and calf from that of the sheep, and that others differ among themselves as to the result of observations on the same samples, and while it is admitted that both kinds of hair are of a very similar structure in respect to the arrangement and details of their medullary, cortical, and cuticular portions, it is still confidently asserted that true wool can be reliably detected by the microscope in mixtures where it occurs. The kinds of hairs observed and described by the commission, may be conveniently arranged in three groups. First, wooly hairs. These mostly extend "from half an inch to several inches in length, without any medulla, and without perceptible taper. They present (especially in the wool of the sheep), at frequent but irregular intervals, well-marked, one-sided, more or less spirally arranged thickenings of the cortical substance, which gives to the wool its curly character. The mean diameter of each hair varies from $\frac{1}{500}$ to the $\frac{1}{1000}$ of an inch, or even less; and the scales of the cuticle are so arranged that their free edges project somewhat, forming well-marked imbrications, of which usually from fifteen to thirty can be counted in the $\frac{1}{100}$ of an inch." Such hairs constitute the wool of commerce, originally limited to the sheep but now applied to the goat, camel, and llama, and similar hairs have long been known to be mixed with the straight hair of various animals, such as the "deer, hare, rabbit, beaver, otter, seal, lion, tiger, certain varieties of dog, and some foreign breeds of oxen." All these hairs are so much alike, structurally, that it is believed they should all be designated as wool, and it is not claimed that the animal from which they were derived can be uniformly and reliably determined by the microscope. Obviously some of these varieties not now recognized as wool might in the future become of sufficient commercial importance to require either the legalization of them all as "wool," or the discovery of more complete methods of discrimination. Second, straight hairs. These are often shorter, "much thicker at their base, and taper rapidly towards the point. The medulla occupies a large proportional part of the whole hair, and the free edges of the scales of the cuticle, which are so disposed as to form from twenty to forty imbrications to the $\frac{1}{100}$ of an inch, lie quite smoothly upon the surface of the hairs, so that their contours, as seen under the microscope, closely approximate continuous lines. These characters are so well marked that the coarser hairs of the cow and calf can readily be distinguished from the woolly hairs of any of the wool-bearing animals." Naturally mixed with the wool of the sheep, however, especially with the inferior grades, and with that of the goat, forming the "outer coat" of the goat, are coarse, straight hairs, so closely resembling some of the hairs of the cow or calf that their discrimination presents great difficulties; and such hairs, even when derived from the wool-bearing animals, cannot be recognized as wool by the microscope. The percentage of "wool," therefore, as determined in mixed fabrics, by a microscopical count of hairs, would probably be underrated in a certain proportion of cases. In case all woolly hairs which are "more or less crispy, curled, or frizzled" should be legalized as wool, it would probably be convenient to make an exception, admitting as genuine wool such a percentage of straight hairs as is found to be present in a specified quality of the sheep's coat. Third, doubtful hairs. Among the imbricated hairs of the wool of the sheep some are occasionally found which so closely resemble the softer hairs of the cow or calf that the investigators confess themselves unable to discriminate between them in all instances. Hairs of this description are therefore more properly classed as doubtful, than included in either of the other groups.

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[1] Conducted by Dr. R. H. Ward, Troy, N. Y.

ANIMAL AND VEGETABLE CELLULOSE AND STARCH. — Mr. Thomas Taylor has contributed to a late Monthly Report of the Department of Agriculture some interesting experiments by which starch-like bodies are artificially produced. On a fibre of cotton is placed a drop of a strong, amber-colored tincture of iodine, followed by a drop of commercial muriatic acid, and immediately afterwards by a drop of concentrated sulphuric acid. The combination of the sulphuric acid with the water of the muriatic causes the liquid to boil for two or three seconds, and the cellulose or cotton fibre is changed, as shown under a power of about one hundred diameters, into the form of disks or beads of a well-defined blue color. A similar change can likewise be produced in flax, and in a variety of vegetable tissues. Fresh animal tissues yield a somewhat similar result, brain, heart, liver, muscles, etc., having been successfully experimented upon. Fibrine of blood, both human and bird's, dissolved in caustic potash and precipitated by acetic acid, gives well-characterized granules, a result which is confirmed by hundreds of experiments.

ARRANGED POLLENS. — Mr. J. A. Langstroth has presented to the San Francisco Microscopical Society slides having pollen from different species of flowers, arranged on the same slide for convenience of comparative study.

EFFECT OF APERTURE ON DEFINITION. — Mr. J. Zentmayer, in a very clear lecture on the elementary properties of lenses, published in the *Journal of the Franklin Institute*, May and June, 1876, calls attention prominently to the confusion of images necessarily attendant upon large apertures, except when viewing absolutely flat objects, from the stereoscopic character of the images formed by different portions of the surface of the lens, the image formed by pencils transmitted by one side of the lens being unavoidably different from corresponding images formed by the opposite side of the lens.

MICROSCOPICAL EXAMINATION OF CRUDE DRUGS. — Prof. M. W. Harrington, whose well-known success in this branch of study gives interest to any production for which he is responsible, being not yet ready to publish his work on the Identification of Vegetable Drugs, Foods, and Fibres, has caused the publication in pamphlet form (by John Moore, publisher, Ann Arbor, Mich.) of the Introduction and Analytical Tables with which the book will be furnished. The brief introductory part contains a few excellent general suggestions in regard to this kind of work, while the analytical tables are a novel and able application of the methods of the artificial keys of modern works on botany to this field of microscopical research. The tables are published now, and in this form, partly for convenience in class use in teaching, and partly that they may, by the test of practical use, receive any necessary corrections or additions before the publication of the full work.

Aperture of Objectives. — Mr. F. H. Wenham's experiments with the slit as a means of cutting off the lateral rays of an objective have led him to announce the belief, in the *Monthly Microscopical Journal*, that an excessive or false aperture is attributed to all objectives by the lateral pencils which direct light far beyond the axial one, and thus greatly enlarge the diameter of the proper light disk. An aperture mapped out on a screen shows the false aperture faintly portrayed as an outer circle of light, while the true aperture, as obtained by the slit, gives a bright, oval disk within the other. As an example of the effect of the slit in reducing to what he regards as the true aperture, he mentions the following reduction of the nominal angles of three lenses made nearly twenty years ago: a $\frac{1}{5}$ of 100° to 56°, a $\frac{1}{8}$ of 130° to 92°, and a $\frac{1}{12}$ of 170° to 100°. He invites discussion upon this novel and very interesting question, which ought to excite the greatest attention until settled beyond dispute.

Mr. Wenham now uses a slit of fixed width, cut through an opaque film upon a glass slip 3x1, being substantially the method contrived by Mr. Tolles, and published in the Naturalist for March, 1875. He also adopts without credit Mr. Tolles' plan of covering the slit with a balsam-mounted thin cover-glass, so that the objective can be adjusted and tested under natural conditions.

Photographing the Nineteenth Band. — Count Castracane has photographed, apparently successfully, Nobert's nineteenth band. with an amplification of eight hundred diameters obtained by means of a Gundlach dry lens of $\frac{1}{13}$ German inch focus. The object was illuminated by an achromatic condenser of large angle, and with a large central stop. The resolution of this band of lines of $\frac{1}{112320}$ inch by a dry lens, has not been generally deemed possible heretofore. The genuineness of the photographic lines was established by micrometric measurement. This success, if reliable, seems an invasion of Helmholtz's theory on the ultimate limits of microscopic power ; but such theories seldom live long.

Popular Microscopy. — The increasing use of the microscope among persons of previously unscientific habits and education is nowhere better shown than by the demand for what is called a popular method of treating the subject in books and journals. Mr. John Phin's little book on the Selection and Use of the Microscope, intended for beginners, in which the subject is simplified and rendered elementary to a greater extent than ever before in a really scientific work, was so well received as to lead, apparently, to the establishment of a periodical, the *American Journal of Microscopy*, a monthly magazine published in the same spirit and under the same management.

An Easy Nitzschia. — The No. 19 of Möller's test plate, resolved into beads by the Nachet No. 5 objective of the San Francisco Microscopical Society, proves to be an anomalously easy shell. The objective fails on No. 19 of other slides by the same maker. Mr. Hyde is of the opinion that the resolved shell is a true *Nitzschia curvula,* although so exceptionally easy that it is resolved by any good $\frac{1}{5}$.

COLLECTING DIATOMS. — Much of the difficulty of making reasonably clean collections of diatoms may be obviated by using Mr. John Redmayne's method, which is described in *Science-Gossip.* A wide-mouthed bottle is attached to a cane in the usual manner, but instead of being open it is closed by a tightly fitting cork, through which are passed two glass tubes, terminating near the bottom of the vial. Externally one of these tubes is slightly bent sideways, so that its outer end can be easily approximated to a deposit of diatoms at the bottom of the water, while the other tube is bent at right angles immediately above the cork, and joined to a flexible rubber tube, which extends up to the handle of the cane. By compressing the rubber tube against the cane with the thumb of one hand, the bottle can be readily brought empty into position, when the calibre of the tube is restored by removing the thumb, and the pressure of water forces air out and water in, carrying the desired objects with it. Should the water be too shallow to afford enough pressure, suction at the upper end of the flexible tube may be employed to exhaust the air, and thus secure a rush of water into the bottle, a glass tube or ball pipette serving as a mouthpiece.

If too muddy, the gathering may be further cleaned by placing it in a long bottle, the bottom of which is covered with black paper. Thus arranged, and placed in the sunlight, the diatoms will soon free themselves from the mud and rise to the surface of the water.

MICRO-PHOTOGRAPHY. — Dr. Edward J. Gayers, of Calcutta, in his work at micro-photography takes his position near the microscope where it and the illuminating reflector can be manipulated with the greatest ease, while the image on the focusing screen is examined with a small telescope consisting of a large opera-glass objective and a microscopical ocular.

WATER ANALYSIS. — While there is still great doubt as to the exact influence or significance of forms perceptible by the microscope in drinking-water, there is no doubt a very general interest in studying and recognizing these forms. In such study good use may be made of Dr. J. D. Macdonald's work on Water Analysis, in which a large number of the more common forms of mineral and organic constituents are figured in rather crude but very suggestive and natural-looking pen-sketches, which are better as a means of recognition than the elaborate and flattering steel-engravings often used. Accompanying the drawings is a good synopsis of the subject in a few pages of print, which will be convenient even to those who have access to libraries of more elaborate works.

PRACTICAL HISTOLOGY. — A good hand-book for students in the histological laboratory is the little publication of Outlines, by Dr. Rutherford, first issued in a journal some years ago, and lately enlarged and improved in an interleaved edition for laboratory use.

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SCIENTIFIC NEWS.

— Near Gilroy, California, is a rose-tree of the cloth-of-gold variety twelve years old, the stock of which is *seventeen* inches in circumference, and, though closely pruned, the branches spread five feet on every side of the trunk.

— In the museum of the California Academy of Sciences is a transverse section of a lemon verbena six inches in diameter. The wood is fine-grained, of a greenish-yellow color, and takes a good polish.

— Our readers may remember a statement by Professor Snow in the NATURALIST, ix. 665, to the effect that the female of the white pelican has a horny crest on the mandible as well as the male. Mr. George B. Sennett, of Erie, Pa., writes us that in two females shot in Grant Co., Minn., the crest was as perfect in proportion to the size of the bill as in the males.

— Mr. James T. Gardner, at present Secretary of the American Geographical Society, has been appointed director of a proposed Geographical Survey of the State of New York.

— A Monograph of the Phalænidæ or Geometrid Moths of the United States, by A. S. Packard, Jr., forms vol. x. of the final reports of the United States Geological Survey of the Territories, F. V. Hayden in charge. Although a formal notice of this work would for obvious reasons not be in place in this journal, the author would beg leave to call the attention of naturalists to matter contained in the introductory portion, especially to the chapters entitled Comparative Anatomy of the Head, Comparative Anatomy of the Thorax, Development of the Thorax of the Imago, Secondary Sexual Characters of the Imago, and to the essay on Geographical Distribution. The imagines of about four hundred species and the early stages of some are described and figured.

— Professor Huxley, who is now on a short visit to this country, will deliver three lectures in New York September 18th, 20th, and 22d, on the "Direct Evidence of Evolution," and also give an address at the opening of the Johns Hopkins University.

— It is well to signalize the close of a great work which has been in progress for twenty-five years, — the *Genera des Coléoptères* of Lacordaire and Chapuis. The work was first assigned to Lacordaire of Belgium and Carreño of Spain ; Carreño, however, died before the plan of the project was definitely settled, and Lacordaire undertook it alone. The first volume was published in 1854. At the death of Lacordaire, in 1870, Chapuis took his place, and has now completed the work, which consists of twelve volumes, two of them double, illustrated by one hundred and thirty-four plates. It treats of about six thousand genera; in the nine volumes by Lacordaire the species of each genus are enumerated; but Chapuis has considered this unnecessary since the appearance of Gemminger and Harold's Catalogue. Each volume has an index of its own, and the final volume (published in April), a systematic and alphabetical index to the whole, occupying over one hundred and fifty species.

—The Annals, published by the late Lyceum of Natural History for over half a century, will be continued under the name of Annals of the New York Academy of Sciences, by that Society. Contributions to its pages, and subscriptions, are respectfully solicited. The yearly subscription is two dollars, payable in advance. Communications may be addressed to Prof. D. S. Martin.

— We have from time to time drawn the attention of our readers to the zoölogical station founded by Dr. Dohrn at Naples. How useful this aquarium and laboratory combined has proved to zoölogists in Europe is shown by the very satisfactory first annual report, just issued. The large building is situated on the Villa Reale or royal park of Naples, a yard and a half below the level of the sea, on the sand-beach of the shore of the Bay of Naples. The lower story or basement is divided into two sections, containing a cistern room of seven hundred and four square yards, with conduit, engine, and pump rooms. Four four-inch pumps maintain a constant circulation in the large aquarium, and there are pumps for filling the smaller aquaria and for pumping in the sea water. The larger basin contains one hundred and twelve cubic yards (metres) of water. The room for the public is two hundred and sixty square yards in extent, and there is a large and thoroughly equipped laboratory, a library, rooms, with a large corps of assistants, including four fishermen, who are constantly collecting material. The station cost about $75,000, and the annual running expenses appear to be about $10,000. The report closes with an extended list of apparatus for laboratory work and a table showing the time of appearance of the different species of animals and their reproductive season, of much use to naturalists who may desire to know the particular date for the appearance of certain animals they want to study. The catalogue of those who have worked at the station includes forty-six names of European naturalists, no American among them. There is also a list of museums and universities to which choice collections have been sent.

— The geology and physical geography of Otago, a portion of New Zealand, is discussed in a report to the Provincial Council of Otago, by Messrs. Hutton and Ulrich. The volume is illustrated by a colored geological map and lithographic plates, and conveys a good idea of the scenic and geologic features of New Zealand.

PROCEEDINGS OF SOCIETIES.

Academy of Natural Sciences, Philadelphia. — May 9th. Dr. Leidy observed that the so-called phosphate beds of Ashley River, South Carolina, were remarkable for the irregular admixture of multitudes of fossils of different ages, from the early tertiary period inclusive down to the present epoch. The phosphatic nodules, for which the beds are explored, appear to have had their origin from the eocene rocks beneath. These have also contributed numerous remains of marine vertebrates, especially of Zeuglodonts, reptiles and fishes. Mingled in the sand and clay with the phosphatic nodules and bones of eocene animals are innumerable remains of cetaceans, sharks, and other marine animals of perhaps the middle and later tertiary ages. Added to these are multitudes of remains of both marine and terrestrial animals of the quaternary period. Mingled pell-mell are found bones of the eocene Zeuglodonts — animals related to the whales and seals; hosts of teeth of the great eocene shark, *Carcharodon angustidens;* myriads of the teeth of the giant sharks of the later tertiary periods, the *Carcharodon megalodon;* bones and teeth of whales and porpoises; abundance of remains of elephants, mastodons, Megatherium, horse, etc., and occasionally the rude implements of our own immediate ancestors.

From among a collection of fossils from the Ashley phosphate beds, recently submitted to his inspection by Mr. J. M. Gliddon, of the Pacific Guano Company, the specimens were selected which were presented for the examination of the meeting. One of them is a well-preserved tooth of a Megatherium; another, a characteristic portion of the skull of a manatee; a third, a complete tusk of the walrus, indicating a still further point south for the extension of this animal than had been previously known; a fourth, a huge tooth of a cetacean allied to the sperm whale, probably the same as those from the crag of Antwerp, ascribed to Dinoziphius. Besides these there are the beaks of three cetaceans of the little known family of the Ziphioids. These are porpoise-like animals, without teeth in the upper jaw, and usually with but a single pair of teeth in the lower jaw. The beaks composed of the coösified bones of the face are remarkable for their ivory-like density, which probably rendered them available as weapons of defense.

A fourth beak from the same locality, but from another source, belongs to a different species of the same family. These beaks and some associated fossils will form the subject of a paper shortly to be presented to the Academy. The species indicated by the specimens exhibited were described under the names *Choneziphius trachops, Choneziphius ciops, Eboroziphius cœlops*, and *Belemnoziphius prorops.*

Professor Leidy, in continuation, remarked that the remains of life, of any kind, were exceedingly rare in the mesozoic red shales which cross our State about fifteen miles north of us. Hence any fossils what ever from these rocks were of interest. The three cycloid fish scales, and a few detached caudal rays, in the fragments of red shale presented by him this evening, he found on the Perkiomen Railroad, near Yerkes Station, Montgomery County. One of the scales resembles those described by the late Professor E. Emmons, under the name of *Rabdiolepis elegans*, from the mesozoic coal shales of Chatham County, N. C.

Mr. Redfield called the attention of the members to the volume of letters of Zaccheus Collins, belonging to the Academy, which had been recently arranged and bound by him. The volume contains an unbroken series of sixty letters, from Rev. Henry Muhlenberg, of Lancaster, to whom American botany has been so much indebted ; also, a correspondence with his son, Fred. Aug. Muhlenberg, in which we find the history of the transfer of the Muhlenberg Herbarium to the American Philosophical Society.

There are also numerous letters from Stephen Elliot, Dr. Jacob Bigelow, Dr. William P. C. Barton, Dr. William Baldwin, Nuttall, Torrey, Leconte, Sr., and many others well known to the scientific world. It cannot be expected that these letters of sixty years ago can add any new botanical facts to our stock, but they have great interest as illustrating the early history of botanical science in our land, and as revealing to us the obstacles which the student of that day encountered in the scarcity of books and in the difficulty of communication.

Professor Frazer spoke of thinness or minuteness of objects under the microscopic and suggested method of studying, by means of the fluorescent ray, objects at present invisible to the highest powers.

Dr. Hunt stated in reply that microscopists were not willing to be limited in their observations by the calculations of mathematicians, and that the comparative darkness of the fluorescent ray would not be favorable to investigations of the kind.

In continuation Dr. Hunt spoke of the destruction of potato-starch by the fungus causing the potato-rot, and stated that he had observed, under the microscope, the absence of starch in the cells attacked by the Peronospora, although the fact of such invasion being productive of the result described had been denied.

Mr. Thomas Taylor, of the Department of Agriculture, spoke of the effect of frost upon potatoes, and stated that he had found starch at the end of twelve months in frozen tubers. He also observed that the potato fungus would grow in cells devoid of starch, but he had not observed the destruction of granules by the cause referred to.

May 16th. Mr. Thomas Meehan said that what was popularly known as the "sleep of plants," the closing of some kinds at night-fall, though a matter within common observation, had not, so far as he was aware, been made a subject of physiological investigation, with the view to ascertaining the value, if any, of this kind of motion in the economy of plant life. He had recently discovered that by means of this peculiar motion the common *Claytonia Virginica* and some buttercups were fertilized by their own pollen. The fertilization of these plants had been somewhat of a mystery to him, as in view of some prevailing theories of cross fertilization by insect agency, these plants ought not to be self-fertilized, but from repeated observations he was satisfied that no insects had visited plants that had yet seeded abundantly. The process of fertilization in Claytonia and Ranunculus, independent of insect agency, was described minutely.

Plants of course had peculiar functions to perform, and there were pre-ordained plans and special arrangements through which these functions are exercised. But the workings of plant life are so complicated that though we see certain results follow certain movements, we are not always sure that we perceive the great and deeper object arrived at in the order of nature. Hence arose the differences of opinion prevailing in regard to the object of cross fertilization. Some plants had arrangements which seemed to preclude the possibility of self-fertilization, and the assumption followed that nature abhorred close breeding in plants and specially designed such structures to secure the plant against it. He believed that nature had a deeper purpose, as yet unknown, and chiefly because of such instances as he had given this evening, where nature could not abhor close breeding, when the result of the "sleep of plants" was most perfect in securing self-fertilization.

May 23d. Dr. Leidy observed, in continuation of his remarks of the previous meeting, on the extinct animals of the Ashley phosphate beds of South Carolina, that they are remarkable for the multitude of remains of fishes which they contain, especially of sharks and rays. Among the former were the giants of their kind, the *Carcharodon megalodon* and *C. angustidens.* A tooth exhibited of the megalodon shark is five and a half inches long and four and a quarter inches broad at the base. The living white shark, pertaining to the same genus, reaches upward of thirty-five feet in length, and has teeth two inches in length. Supposing the megalodon shark to have reached the same proportions in relation with the size of the fossil teeth, it must have exceeded seventy feet in length, and must have proved the most formidable monster of the ancient ocean.

Another specimen presented for the inspection of the members is a knob of bone, such as is found at the root of the tail of the devil-fish, the largest of the existing rays. In the latter the bone is the only one of the body, and it supports a minute spine, a mere rudiment of the barbed weapon of the sting-ray. Our devil-fish, of which a specimen was once exhibited in Peale's Museum, of this city, reaches a breadth of eighteen feet, with a length of about fifteen feet. The fossil bone, though the only thing left to tell the tale of its former possessor, is quite a characteristic specimen. It is of more robust proportions than that of its living representative, and probably indicates an extinct species, for which the name *Ceratiptera unios* was proposed.

Specimens exhibited of the dental armature of the roof and floor of the mouth of eagle rays were referred to extinct species under the names *Myliobates majester* and *M. mordax*, the former having been one of the largest of its kind. Similar specimens from the eocene marl beds of Monmouth and Burlington counties, N. J., were referred to species with the names of *Myliobates fastigiatus* and *M. jugosus*.

Professor Leidy further directed attention to a specimen of the snout of an extinct cetacean, which he had recently observed among some fossils from the Ashley beds in the Smithsonian collection of the government department of the Centennial Exposition, and which had been obligingly loaned to him for description by Mr. W. P. Blake. The specimen, two and a half feet in length, had the density of ivory, and indicated one of the largest of the little-known family of the ziphioid whales. It was referred to a new genus and species, with the name of *Proroziphius macrops*.

The other fossils are of the giant sloth, the Megatherium, presented by Mr. George T. Lewis, of this city. These were also found in the Ashley deposits, and are probably the remains of animals which became mixed in marshes after the elevation of the Ashley deposits above the ocean level.

June 6th. Professor Cope spoke of the structure of the foot in certain eocene unguiculate mammals. The name Creodonta was proposed for the group. The peculiarities of eocene forms, allied to the lemurs, were described, and other groups were defined under the names Mesodonta, Insectivora, Tillodonta, and Tæniodonta. These were collectively placed under the head of Bunotheria.

Mr. Meehan remarked on the subject of cross fertilization of plants and fertilization by insect agency.

June 13th. At the recent meeting of the Academy, Professor Cope called attention to certain fossil remains from the Rocky Mountains. The physical peculiarities of the region in which they were found were described. Among the specimens were fragments of limb bones indicating an animal of considerable size, which was probably allied to Labyrinthodon or some other huge batrachian. The name *Dystrophæus viæmalæ* was proposed for the form indicated, which is particularly interesting as being the first vertebrate found in the trias of the Rocky Mountains.

June 25th. The members of the Botanical Section reported the holding of a meeting for organization and the election of the following officers: —

Director, Dr. W. S. W. Ruschenberger; vice-director, Thos. Meehan; conservator, C. F. Parker; recorder, Isaac Burk; treasurer, Jose O. Schimmel; secretary, Dr. Leffman.

Dr. Leidy again called attention to the remains of fossil whales from the Ashley River deposits and exhibited another specimen from the Centennial Exposition, for which the name *Prorosiphius conops* was proposed. A fragment of a skull of Squalodon from the same collection was also exhibited. The remarkable admixture of fossils of different geological ages in these deposits was again alluded to.

A tooth of a Megalodon shark, measuring six and seven tenths inches long, was described, and the opinion advanced that, comparing it with teeth of existing sharks, it probably had belonged to an individual upwards of one hundred feet in length.

Professor Cope recorded having seen remains of a cretaceous vertebrate from the deposit spoken of by Dr. Leidy. It belonged to the sixth genus of the order Pythonomorpha and was described under the name of *Cyclotomodon vagrans.*

Professor Cope also exhibited and described a fossil fish from the cretaceous formation of Nebraska. The structure of the mouth was that of the soft-rayed fishes, and the other characters ally it to the group to which belong the mullets. The dentition and the structure of the caudal fin were described and the name *Anogmius aratus* was proposed for the form.

California Academy of Sciences, San Francisco. — April 3d, Professor Davidson read the first of his series of papers on irrigation, harbors, and engineering in Europe and Asia, giving the results of personal observation. The paper was devoted to Indian irrigation, and was rich in interesting details, and in the value of its conclusions applied to the necessities of artificial water-courses in California. The lecturer said that the Indian canals had not paid private capital, and the expense had been assumed by the government, which is projecting and building a magnificent system of irrigating works.

Dr. Hale, a visitor, related an instance of "mimicry" which he observed in the Santa Cruz Mountains. It was a milk-white spider, in shape, size, and color the exact counterpart of the flower Medrono.

April 18th. Captain Bryant, United States Treasury Agent, who is stationed on the Aleutian Fur Seal Islands, was present, and gave a brief history of the habits of the seals and the manner in which they are caught. Notwithstanding the slaughter of one hundred thousand annually by the Alaska Commercial Company, the legal limit under the company's lease from the national government, a careful calculation shows that the seals are increasing, as compared between the year 1869 and the past season, five per cent. in number. The revenue of the government from this source is $325,000 per annum, being nearly five per cent. on the amount paid for the territory of Alaska.

Boston Society of Natural History. — June 7th. Communications were read by Dr. W. K. Brooks on The Separation of the Sexes in Salpa by means of Natural Selection; by Professor A. Hyatt on Old Age among the Ammonites of the Oölitic Formations; and by Mr. W. O. Crosby on the Geology of Eastern Massachusetts.

NEW YORK ACADEMY OF SCIENCES. — April 17th. Mr. George F. Kunz read a note on the Phosphorescence of Pectolite, as distinguishing it from the Zeolites. One of the members exhibited a series of Graptolites from the shales of Norman's Kill.

In a paper on the Causes of the Cold of the Ice Period, Dr. Newberry reviewed, from a geologist's standpoint, the theories proposed to account for the cold of the ice period. He said these theories formed two categories: one, the cosmical; the other, the terrestrial.

In the first, the Glacial Period is attributed to astronomical causes, such as variation in the eccentricity of the earth's orbit, in the angle of the axis of the earth with the ecliptic, or in the quantity of heat received from the sun, the passage of the earth through cold spaces in the universe, etc. The discussion of these theories he left to the astronomer and mathematician.

The terrestrial theories considered were those of Lyell and Dana, in which the cold of the Glacial Period is ascribed to a peculiar distribution of land and water, the land being supposed to be high, broad, and continuous in the arctic regions, forming great condensers of atmospheric moisture, and barriers excluding the tropical currents from the arctic sea; and the theory of Professor Henry, which ascribes the great extension of glaciers in the polar regions to a large amount of moisture thrown into the air in the tropics by volcanic agency. Both these theories, however plausible, are based on conjecture only, and are not supported but are opposed by known facts.

For example, in the Tertiary Period the climate over the arctic regions was as mild as that of our Middle and Southern States. A luxuriant forest covered arctic America, — Greenland, Iceland, etc., — in which were the tulip-tree, magnolias, deciduous cypress, and other plants now growing in the United States. At this time the land was broad, for there are almost no marine Tertiary deposits in the arctic regions, and there was land connection between America and Asia, and between America and Europe, forming barriers which must have excluded tropical ocean currents from the polar sea. On the other hand, the land of the tropical regions in Tertiary times was low, for we find marine Tertiaries bordering or covering the continents and islands.

There is no evidence that the arctic lands were high and broad in the Ice Period, but during at least a portion of this period, Greenland, England, and Scandinavia were much lower than now. At the same time the tropical lands were apparently near their present level.

The objections to the volcanic theory are that we have no evidence of unusual volcanic action in the tropics during the Quaternary age, and it is not certain that the production of a great amount of vapor there would produce glaciers in the arctic regions, as, when ascending to the height of a few thousand feet, the vapor would be locally precipitated. The transfer of heat and moisture from the tropics to the poles is chiefly through oceanic and not through atmospheric currents.

For the reasons given, the terrestrial theories were regarded as inadequate, and the conviction was expressed that we must look to some astronomical cause for an explanation of the phenomena of the Ice Period.

May 15th. Mr. I. C. Russell read a paper on the Ancient Glaciers of New Zealand, and Mr. A. A. Julien remarked on the Search for Flint Implements in the Valley of the Saone.

May 29th. The following papers were read: On Determinations of Specific Gravity by the Arabians of the Twelfth Century, by Dr. H. C. Bolton; Notice of Recent Investigations as to a Change of the Earth's Axis at the Close of the Tertiary, by Professor B. N. Martin.

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SCIENTIFIC SERIALS.[1]

AMERICAN JOURNAL OF SCIENCE AND ARTS. — August. Note on the Development and Homologies of the Anterior Brain-Mass with Sharks and Skates, by B. G. Wilder. The Greenstones of New Hampshire and their Organic Remains, by G. W. Hawes.

THE GEOLOGICAL MAGAZINE. — July. The Carrara Marbles, by G. A. Lebour. Distant Transport of Volcanic Dust, by A. E. Nordenskiöld. On the Mechanics of Glaciers, by D. Burns. Ice and Ice-work in Newfoundland, by J. Milne.

THE GEOGRAPHICAL MAGAZINE. — July. Statistics of Danish Greenland. The Voyage of the Challenger, by J. E. Davis. The Andaman Islands, by F. A. de Roepstorff. A Journey into the Arabian Desert of Egypt, by Drs. Schweinfurth and Güssfeldt. Verrazzano, by R. H. Major.

JENAISCHE ZEITSCHRIFT FÜR NATURWISSENSCHAFT. — April 15th, Ueber Ontogenie und Phylogenie der Insekten, von Paul Mayer.

ANNALS AND MAGAZINE OF NATURAL HISTORY. — July. On the Affinities of the Anthozoa Tabulata, by G. Lindstroöm. *Eozoön Canadense* according to Hahn, by J. W. Dawson.

MONTHLY MICROSCOPICAL JOURNAL. — July. On the Rotifer Conochilus volvox, by Henry Davis. On the Abbé Count Castracane's Photographs of Nobert's Nineteenth Band, by H. C. Sorby. On the Aperture of Object Glasses, by F. H. Wenham. On the Limits of the Optical Capacity of the Microscope, by Professor Helmholtz, with a Preface by Dr. H. Tripp.

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[1] The articles enumerated under this head will be for the most part selected.

THE

AMERICAN NATURALIST.

Vol. x.— OCTOBER, 1876.— No. 10.

PLAIN, PRAIRIE, AND FOREST.

BY PROF. J. D. WHITNEY.

PART I.

IN spite of all that has been written in regard to the distribution of forests on the North American continent, and the origin of those treeless plains to which the name of prairie is given, the subject is one possessing a great deal of interest, since there is far from being any unanimity of opinion about the various points which are involved in it. The publication of Professor Brewer's map, showing in five degrees of density the distribution of woodland within the territory of the United States, and which is one of the series of charts included in General Walker's Statistical Atlas, seems to offer a convenient occasion and excuse for reverting to the subject of the physical conditions influencing the growth of forests. This has long been a favorite theme with the writer of the present article, and during the twenty years which have elapsed since he has published anything in regard to it, he has had many opportunities of making observations on the distribution of plain, prairie, and forest within the borders of the United States, having crossed the continent several times by various routes lying between Wisconsin and Missouri. In these journeyings he has availed himself of the excellent sections afforded by the various railroad lines crossing the States of Indiana, Illinois, Iowa, and Missouri, accumulating observations which, taken in connection with those previously made during several years of detailed geological work in the heart of the prairie region, enable him to speak from personal knowledge of a wide extent of country, embracing, indeed, a large portion of that area of mingled forests and prairies to a discussion of which this article is to be chiefly devoted.

The use of the word "prairie," which corresponds very nearly with our "meadow," meaning a grassy, treeless, nearly level

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area, dates back to the days of the very earliest explorers of the Mississippi Valley. Father Hennepin describes the prairies along the Illinois River exactly as any other observer would now do. He says, "Elle [the river] est bordée de côteaux [bluffs] dont la pente est couverte de bois et de grands arbres. Quand on est sur ces côteaux, on découvre de belles prêries à perte de vûë, garnies d'espace en espace de petits bois, qui semblent avoir été plantez exprès." The distinction between prairie and plain is one which has come gradually into existence as the routes of the emigrant and the explorer have extended themselves farther and farther to the west. Every one knows that the "Prairie States" are those lying contiguous to the Mississippi, on both sides, from Minnesota and Wisconsin down to Arkansas, and that Illinois and Iowa are typical prairie regions. All understand what the phrases "crossing the plains," and "out on the plains," mean; and no Western man would confound the terms prairie and plain. When we reach the Rocky Mountains, and find grassy areas distributed among the ranges, we learn that they are there called "parks" and "holes." This is true, at least, for the central portion of the country, in Colorado and Utah; farther north, in Dakota and Montana, the term prairie is also in use.

For our present purpose it is unnecessary to trace the gradual disappearance of the forests as we proceed west from the well-wooded region of the Appalachian ranges and the Great Lakes. That the distribution of woodland within our territory is in general more influenced by the amount of moisture or the quantity of rain which falls than by any other cause is admitted as a fact beyond dispute. A comparison of the Smithsonian rain-charts with Professor Brewer's map shows this at once. An interesting article might be written on the distribution of the forests over the vast region west of the Rocky Mountains, but with that we have not now to do. It is to the prairie region proper that we propose to devote the present article.

The prairies lie between the forest-covered portion of the country and the plains; hence the idea which seems so firmly fixed in the minds of many, that prairie and plain are the same thing; or, rather, that one is simply passage into the other, the prairie being, so to speak, the incipient plain. It will be necessary, therefore, at first, to show that there is an essential difference between the two kinds of surface, and that their juxtaposition is quite accidental, or certainly depending on other causes than those to which it is commonly attributed.

The prairie is a heavily-grassed area, destitute of forest growth, but existing in the midst of a wooded region, where the climatological conditions are favorable to the growth of timber, but where some other cause than the want of sufficient moisture has operated to prevent this growth. To illustrate how character and distribution of forest and prairie are independent of climatological conditions, let us take the State of Wisconsin, which has an area of about fifty-four thousand square miles, the ninetieth meridian passing nearly through its centre. The northern portion of the State belongs among the most densely wooded regions in the country. This heavily-timbered belt extends from Lake Superior south to the forty-fifth parallel. The sugar-maple is the predominating tree. South of this is a region of pines, not as thickly crowded together as are the trees in the region to the north, but constituting fine forests; still farther south, and occupying the whole area south of the Wisconsin River, is a region of mingled forest and prairie, the trees being chiefly oaks. The cause of this peculiar distribution of the timber in Wisconsin will be noticed farther on; at present it is only desired that the attention of the reader should be called to the entire want of harmony of this arrangement of forest and prairie with the climatological conditions. The Smithsonian charts show a greater amount of precipitation over the prairie area than anywhere else in the State. By no amount of ingenuity can the peculiarities of the isothermal or isohyetal lines be made to play in with the marked differences of the vegetation.

Equally striking are the changes which are met with as one passes from the State of Indiana into the adjacent one of Illinois. The former of these is forest-covered, woodlands extending over probably as much as seven eighths of its area; Illinois, on the other hand, is *par excellence* the prairie State, not more than a quarter or at the most a third of its surface being covered with timber. Here, again, there is nothing to coincide with the distribution either of rain or of temperature; the division seems a purely arbitrary one until looked at in the light of geology. These are only two instances, out of many which might be cited, going to show the absence in certain regions of any essential connection between climate and distribution of forests, and these are sufficient at any rate to indicate the desirability of inquiring what other causes may exist, determining, at least to a considerable extent, the curious intermixture of grassed and timbered areas which we find in the prairie region proper.

The writer has no theory to put forward on the subject; he has simply gone on for years observing the facts, and it is a very brief *résumé* of these facts which it is here proposed to give. But he will first endeavor to dispose of some of the theories of others, declaring that he believes himself to have had better opportunities for observing in the prairie region than any of the writers who of late years have taken up this subject.

There seem to be two prominent theories before the public for their choice in accounting for the existence of the prairies. One of these may be very shortly disposed of, since it is so at variance with all the facts that, as Mr. Foster observes,[1] it is "worthy only of a passing notice." It is to the effect that the prairies exist because the trees have been burned off by the Indians! To use the words of Mr. St. John, formerly State Geologist of Iowa, and one of the most zealous upholders of this theory, "The real cause of the present existence of the prairies is the prevalence of the annual fires. If these had been prevented fifty years ago, Iowa would now be a timbered instead of a prairie State." There seem to be some Western men who are not content unless they can make their country out to be not only the garden but the arboretum of the world. The trees are wanting at present over extensive areas; but they must once have existed, otherwise the Mississippi Valley would be or have been deficient in one of those attributes by which an ideally perfect country is characterized. As the trees do not now exist, they must have been destroyed, and, no other agent being at hand so destructive as fire, that is had recourse to. The prairie grass frequently gets on fire; these fires have burned up the trees! Why the same conditions do not hold good on the present forest-covered States has never been explained. Why the fires have spread themselves only on comparatively level ground, and spared the mounds and the bluffy sides of the rivers, is also a mystery; equally so why they have avoided certain tracts quite surrounded by prairie, like the "groves" of Wisconsin; and, furthermore, why they have paid such respect to the differences of soils and other geological conditions. We have seen large areas of forest burned over, both in New England and on Lake Superior, as well as in the Rocky Mountains, but have no recollection of any of these areas having become prairies in consequence. Once a forest, always a forest, so far as our experience goes, unless the hand of man comes in to interfere with nature. Mr. N. H. Winchell, although an advocate of the prairie fire theory, seems much impressed with one of the difficulties which it presents, namely, the irregularity with which prairie and forest are intermingled. Speaking of the "Big Woods" of Minnesota, a belt of timber some forty-five miles wide, running from the centre of the State to the northern boundary of Iowa, he says, "The existence of this great spur of timber, shooting so far south from the northern forests, and its successful resistance against the fires that formerly must have raged annually on both sides, is a phenomenon in the natural history of the State that challenges the scrutiny of all observers." We wonder that it had not led him to scrutinize his own theoretical ideas. Of the real cause of the existence of these "Big Woods" we will speak farther on.

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[1] The Mississippi Valley, page 76. Dr. Newberry says the idea is "simply puerile." (Geology of Ohio, i. 30.)

By some writers on the theory of the prairies it is held that, as trees can be artificially made to grow upon them, therefore they must originally have been covered by a forest vegetation. This is as if one should argue that because the western part of the State of New York is covered with flourishing wheat fields, and because grain can be raised there with ease, therefore that region must have been always a treeless one!

Let us turn now to the other and by far the most prominent theory advanced to account for the existence of the prairies. It is this: that these treeless plains are in some way a product of the climatological conditions of the country. The only causes connected with climate which we can conceive of as likely to influence the growth of forests are temperature, force of the winds, and moisture; if the latter be the effective agent in determining the position of the wooded regions, then it may be through either excess, deficiency, or irregular distribution of the moisture that the result is attained. In regard to the first of these causes, namely, temperature, we are not aware that this has ever been suggested as having anything to do with the phenomenon in question. There seems to be nothing in the distribution of the isothermal lines in the Mississippi Valley which could be in any way connected with the presence or absence of forests, and certainly nothing connected with the details of the distribution of woodland and prairie could be at all explained by reference to temperature. In regard to the winds, it will be admitted that these do sweep pretty severely over the prairie region, for the reason that it is mostly flat, and therefore unsheltered. That the winds on the Pacific coast are, in places, inimical to the growth of forests seems very clear, but this does not seem to be the case in the Mississippi Valley, for we often find the most abundant growth of trees on the very spots which are most exposed to the force of the blast. It is on the rising ground, the knobs, knolls, and mounds which are scattered over the surface of the prairie, that those isolated clumps of timber, called groves, are most likely to be found. If the force of the wind were essentially inimical to the growth of trees, we should find them thriving, if anywhere, in the sheltered nooks, and to the leeward of the northwesters, that being the quarter from which the heaviest blasts come. This is not the case, nor is there anything, so far as we have observed, which would lead to the conclusion that the force or direction of the wind has any sensible effect on the growth or distribution of the timber in the prairie region.

The only climatological cause for the existence of the prairies which is worthy of serious consideration in this connection is the distribution of moisture, and by far the larger number of those who have written on this question have unhesitatingly asserted that in something connected with the rain-fall was to be found the really efficient agent by which the distribution of woodland and prairie has been effected. Exactly what this something is seems, however, not easily to be made out. It must, as it would appear, be one of four things: either the annual rain-fall is on the whole deficient, or it is not favorably distributed through the seasons, or the climate is subject to cycles of drought, or there must be an excess of moisture. In one or other of these categories the influence of the rain-fall must be found, or if not in one single condition of these here enumerated, then in some combination of them.

Let us first examine whether the average annual rain-fall is really deficient, so that the absence of trees over a considerable portion of the Mississippi Valley may be referred to this as a cause. And to settle this question we have no better method than that of comparison between the wooded and prairie regions, taking the Smithsonian rain-charts as a basis for our statements. These charts are, of course, for many districts only rough approximations; for it is, over a large part of the country, only within a few years that statistics have begun to be collected. The data seem, however, to be sufficient for our purpose. If now we examine these charts, we find that for the typical prairie region, namely, Southern Wisconsin, Illinois, Eastern Iowa, Missouri, and Arkansas, there is no deficiency of rain-fall indicated. Beginning in the densely-wooded region of Northeastern Maine, and following along through the forest-covered districts of Northern New Hampshire and Vermont, New York, the southern part of Upper Canada, the southern part of Michigan, Ohio, Indiana, and so on as far as the Des Moines River, we find spread upon the chart a uniform tint of color, designating an annual rain-fall, over the whole area indicated, of from thirty-two to forty-four inches. This same shade of color extends down and covers almost the whole of the densely-wooded Appalachian ranges in Pennsylvania, Virginia, and North and South Carolina. Looking at the curves which imperfectly divide the region in question, giving a greater amount of detail, we see that not only is the annual precipitation in general quite as great in the prairie region as in most of the ordinarily well-wooded parts of the country, but that when local causes have within certain areas given rise to an excess or deficiency, as compared with the general range of from thirty-two to forty-four inches, there is no corresponding difference in the relative abundance or scarcity of the forests. Thus the upper heavily-timbered part of Michigan shows a decided deficiency of rain-fall, while the only region in that State in which prairies occur over any considerable amount of surface, namely, the southwestern corner, is precisely that where the amount of rain is exceptionally large. Wisconsin, again, shows the same kind of anomaly, for here the prairie region is seen to have the largest amount of precipitation of any portion of the State. Once more: in Iowa, there is a district which is almost entirely covered with forests, namely, the northeastern corner; here, by a curious coincidence, the Smithsonian charts indicate a decided deficiency of rain; while farther west, in a line extending northwest from Iowa City, there is a large area of considerable extent marked as receiving from forty-four to fifty-six inches, and over which, as repeated explorations have convinced us, there is no corresponding increase in the amount of timber. Still more striking facts of the same kind may be had in abundance in Southern Missouri and Northern Arkansas, a region of abundant prairies and of precipitation as great as that of the wettest part of the Atlantic coast. Further statements of this kind do not seem to be necessary to justify the conclusion that in the prairie region there is no deficiency in the annual amount of rain, and that some other cause for the absence of forests over a considerable portion of the Mississippi Valley must be sought for.

Let us next inquire whether there is anything in the distribution of the rain-fall throughout the year or from season to season which may possibly have a peculiar influence on the vegetation. That this is the case, and that this is, in fact, the predominant cause determining the existence of the prairie, is the theory advocated by Mr. J. W. Foster, at some length, in his work entitled The Mississippi Valley. Mr. Foster thus states his views: "Wherever the moisture is equable and abundant we have the densely-clothed forest, wherever it is unequally distributed we have the grassy plain, and where it is mostly withheld we have the inhospitable desert." That the last of these three dicta is true may be at once admitted. No one will deny that some moisture is necessary to the growth of vegetation, whether it consist of trees, shrubs, or grasses. The other parts of this statement, as we contend, are entirely erroneous. And no better instance can be given of the fact that an equable and abundant distribution of moisture does not always clothe the country with dense forests than that of the vicinity of Chicago itself, where Mr. Foster's book was written. Here we have one of the finest prairie regions in the world, absolutely destitute of trees, and yet in the full enjoyment of an abundant precipitation, and in the immediate vicinity of an immense sheet of water. For Chicago itself, indeed, the statistics of rain-fall are very defective, but such as they are, they are entirely unfavorable to Mr. Foster's hypothesis. Points in the immediate vicinity of that city, where observations have been taken for a series of years, show an annual average rain-fall of from thirty-six to fifty inches, pretty uniformly distributed through the year, as will be seen farther on. An excellent instance, on the other hand, of a dense growth of trees combined with the most unequally distributed rain-fall which is possible is furnished by the western slope of the Sierra Nevada of California, whose magnificent forests are well known, as also is the fact that there is no precipitation there at all for six months of the year, nearly the whole of the rain-fail being limited to three months. And, lest it may be thought that melting snow keeps the ground moist during the summer, it may be added that the heaviest forest belt of the Sierra is quite below the line above which snow rests for any considerable time, and that the soil in that belt is usually perfectly dry at the surface, and even dusty, for six months of the year, and often much more.

From other parts of Mr. Foster's chapters on the origin of prairies, in his work already cited, it would appear, however, that he considers the deficiency of rain in the winter months to be the essential cause of the absence of forests. He remarks as follows:[1] "A region where the annual precipitation is slightly in excess of twenty inches, I infer from observation, is unfavorable to the growth of trees, even were this moisture equally distributed, but where three fourths of it is precipitated during the spring and summer, the grasses flourish and mature to the exclusion of arborescent forms." This seems also to be the theory advocated by Dr. Newberry, from whom we quote as follows:[2] "Those who know anything of the climate of the prairie belt know that it is characterized by a *deficiency* of *winter rain* and snow, and by occasional though rare seasons of excessive dryness. The want of winter rains to deeply saturate the ground gives to the superficial hibernating grasses, which may be said to live upon the almost copious summer rains, an advantage over trees equal to a victory."

Let us now examine this question in the light of the Smithsonian rain-tables and Mr. Schott's discussion of them. This very point is taken up, under the head of Annual Fluctuation in the Rain-Fall, annual fluctuation, as Mr. Schott explains it, meaning the "changes from month to month." He gives the typical curve for the "region embraced in the Hudson River Valley, Vermont, and Northern and Western New York," as derived from an aggregate of five hundred and sixty-four years of observation. He also gives from the records of one hundred and fourteen years the curve for "the Upper Mississippi from Fort Madison, Southern Iowa, to Fort Ripley, Central Minnesota, and including part of Wisconsin." One of these regions, as will be readily seen, is a region of forests, the other of prairies. It would be difficult to select two districts in this country of equal area more characteristically situated for showing the difference between the rain-fall of a wooded and of a prairie country. Yet we find Mr. Schott declaring that the two curves thus obtained, and representing typically the distribution of the rain-fall throughout the year, "do not materially differ." In each case there are two maxima, one about the beginning of the summer and the other at its end, and also a principal minimum about the beginning of February. The only difference between the two types is that in the one case one of the maxima falls in September and in the other in October, and that the range is a little larger in the more westerly region. We find, on examination of the tables, that from about forty to forty-five per cent. of the total precipitation of the prairie region comes in the autumn and winter months, and that these conditions do not materially differ from those prevailing in some of the most densely-wooded portions of the country. To illustrate these points we append a table showing the amount of precipitation at some of those places in the prairie region where observations have been longest kept up, with additional figures from some portions of the densely-timbered country.

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[1] Mississippi Valley, page 101.

[2] Geology of Ohio, i. 30.

	PRECIPITATION, IN INCHES.				Total, in Inches.
	Spring.	Summer.	Autumn.	Winter.	
Peoria, Ill	10.00	10.34	8.46	7.03	35.83
Ottawa, Ill	9.89	11.25	8.68	7.37	37.19
Manchester, Ill	11.49	8.71	8.76	8.83	37.79
Athens, Ill	11.55	12.04	8.55	7.48	39.62
Pekin, Ill	10.44	12.50	9.45	8.86	41.25
Winnebago, Ill	9.72	12.31	9.66	6.14	37 83
Platteville, Wis	9.88	13.63	9.32	6.48	39.31
Dubuque, Iowa	7.10	10.53	9.38	5.23	32.24
Muscatine, Iowa	11.92	13.79	10.35	6.82	42.88
Iowa City, Iowa	11.27	13.04	13.11	5.70	43.12
Clinton, Iowa	11.40	13.94	10.40	7.98	43.72
Davenport, Iowa	10.70	13.71	8.56	6.49	39.46
St. Louis, Mo	12.42	13.04	9.07	7.65	42.18
Ontonagon, Mich	5.43	7.44	6.48	6.44	25.79
Marquette, Mich	6.49	9.02	8.11	6.39	30.01
Fort Brady, Mich	5.06	9.59	10.68	4.99	30.32
Detroit, Mich	8.51	9.29	7.41	4.82	30.03

The last four places are situated in thickly wooded regions, the others are on or near the prairies, and they include nearly all the localities in Illinois and Iowa where observations have been kept up for as much as ten years. Attention is called to the small annual amount of rain in the densely-timbered districts bordering on Lake Superior and Lake Huron, and also to the fact that there the statistics of its distribution through the seasons are much more unfavorable to the growth of forests, according to Mr. Foster's theory, than anywhere on the prairies.

In view of the above figures it may be unhesitatingly affirmed that there is no basis for the theory that an unequal distribution of rain throughout the year brings about a treeless condition of the surface. It is surprising that those who maintain that a deficiency of winter rain prevents the growth of trees should not have recollected that over a large part of the forest region of the north and northeast there is, practically speaking, no precipitation at all in the winter, since the snow which then falls, to the exclusion of rain, accumulates on the frozen surface and does not begin to wet the ground until spring, when it, to all intents and purposes, by its melting adds so much to the spring precipitation, thus bringing the total effect exactly to a par with that which is claimed by Dr. Newberry as being fatal to the existence of forests.

When we come to examine into the conditions of the climate in Southern Missouri and Arkansas, which are also regions of extensive prairies, we find that there is still less reason for advocating a deficiency of moisture as the cause of the treeless condition of the surface than there is farther north in the States for which statistics have been given. The tables of the rain-fall are very deficient for the region west of the Mississippi and south of the Missouri. Arkansas, however, is put down on the Smithsonian charts as lying chiefly within the belt of forty-four to fifty-six inches of precipitation. There are only two stations where observations have been kept up for any length of time; these are Washington, in longitude 93° 41′ and latitude 33° 44′, and Fort Smith, on the extreme western border of the State. At these places a precipitation of 54.50 and 40.36 inches is indicated. Short series at Helena and in Union County give respectively 81.08 and 74.63 inches. Helena, with this enormous precipitation, is the nearest station to Prairie County, of which the surface is "mostly open prairie."[1] An examination of the Smithsonian charts will show that Southern Missouri is also a region of large precipitation. Here there is considerable prairie, some of it in the river bottoms. The region is a rough and broken one, and the conditions of soil and surface quite complicated with respect to distribution and character of timber. There is a considerable area covered with a scattered growth of oaks, locally known as "oak barrens." These, however, do not depend for their existence on any scarcity of moisture.

As there is no proof whatever that an occasional year of drought in the prairie region would be a sufficient cause for the absence of timber, and as there is, furthermore, no proof that this region is peculiarly liable to droughts, it is hardly necessary to take this matter into serious consideration. It would be easy to point out regions on the Pacific coast and elsewhere in which the distribution of the rain from year to year is very capricious, but where, none the less, the forests are well maintained. Mr. Schott's investigations give us no authority for saying that the prairie region is more liable to droughts than the region of forest immediately adjacent to it.[1]

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[1] D. D. Owen, First Arkansas Report, page 242.

That an excess of moisture is in general prejudicial to tree-growth must of necessity be admitted. This fact seems to form the basis of the views of Mr. Lesquereux in regard to the origin of prairies. And to a considerable extent there is a harmony of opinion between us; indeed, the writer finds that this gentleman is the only one of those who have written on the prairies who has carefully observed the leading facts. Before, however, noticing his views, it will be well that the author of this article should state exactly to what results his own observations have led him, and what seems to him the all-important consideration influencing the character of the vegetation in the prairie region.

(To be concluded in the next number.)

CARNIVOROUS PLANTS.

BY PROF. W. J. BEAL.

THIS is a new term which has lately been applied to plants that catch insects by various contrivances.

In 1768, over one hundred years ago, Mr. Ellis discovered that the Venus fly-trap, of North Carolina, catches insects by a peculiar construction of the tips of its leaves, like a steel-trap. Numerous experiments have satisfied botanists that flies are not only caught, but digested by a fluid poured out by the plant, and the materials absorbed into the tissues of the plant. In 1780, ninety-five years ago, the sun-dew (*Drosera*) was found to catch insects by its sensitive hairs with a sticky gland at the end of each.

Drosera rotundifolia, a common little plant of our marshes, has a round leaf, about the size of a cent, sometimes containing eighteen small flies. The glandular hairs move toward the fly when irritated.

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[1] See page 158 of Mr. Schott's paper. He says, "The observed succession of annual amounts of rain-fall on the Atlantic coast from Maine to Virginia, and in the interior of the State of New York, seems to be governed by the same circumstances or laws, as is evident by a comparison of the curves of Type I. [Maine to Virginia] and Type II. [State of New York], and indeed Type III., region of the Upper Mississippi (Iowa), bears some resemblance to these curves, but is not yet sufficiently developed to be pronounced identical in character. . . . . The remarkable period of droughts about 1836, as well as the less conspicuous or relative one of 1855, are common to the two regions [Type I., State of New York, and Type IV., region of Upper Mississippi, Iowa]."

Drosera longifolia has a very long, slender leaf, also covered with glandular hairs. It rapidly coils up from the tip, catching flies, which it devours and absorbs.

North America has eight species of pitcher plants (*Sarraceniaceæ*) the leaves of which catch insects. They have stiff hairs inside, pointing downward, which prevent the escape of most insects. Some have a sweet secretion below the opening at the top on the outside. This grows sweeter and sweeter and more abundant, till it comes to the opening, to entice foolish flies to the fatal pit whence no fly ever returns.

Catesby, some years ago, thought these pitchers were an asylum for insects to escape from frogs and other animals. I have here some fresh specimens of *Sarracenia purpurea*, the only pitcher plant found in Michigan. Pouchet, in his popular book, The Universe, speaking of this plant, says, "The leaves rise from spot to spot at the feet of the traveler, and are filled with pure and delicious water, for the benefit of which he is all the more grateful that he is encircled by nothing but marshes." The truth is, the water abounds in rotten bugs and worms.

Of *Nepenthes* there are some thirty species, most of which secrete honey on some parts of their pitchers, to entice insects, which they catch and devour.

The spathe of *Alocasia*, it is said, catches slugs and destroys them in a strong secretion. For a full account of the above interesting plants, see Dr. Hooker's Inaugural Address, last year, at the British Association, printed in *Nature*, x. 366.

Pinguicula catches insects.

According to Mrs. Treat, bladderworts (*Utricularia*) catch infusoria and other small animals. These are taken by strange devices in the little bladders, which work like some miniature eel trap. The animals are dissolved and contents absorbed by the plant. In addition to the above, we have quite a large number of other plants belonging to divers natural orders, which catch insects. The young leaves and stems of *Rhododendron* is one of them. A species of *Plumbago* in the green-house, sent from the Agricultural Department at Washington, has viscid hairs about the flowers, large enough to catch and hold a common house-fly, even if caught by one or two legs. Several species of *Polanisia*, *Cupœa viscosa*, some species of *Physalis*, and *Solanum*, catch small insects by sticky hairs on the younger portions of the plant.

Many species of *Silene* attract, catch, and hold insects to such an extent that the genus goes by the popular name of "catch-fly."

Lychnis vespertina, a kind of cockle sometimes in our wheat fields, also takes small insects. It seems to digest them by the small glands at the end of the hairs. We need not necessarily suppose that they are digested because they are captured by sticky plants.

The large bud scales of the horse-chestnut and balsam poplar, in the spring of the year, are often found holding insects by the sticky varnish with which the buds are very copiously covered. We see that the varnish may be of use to protect the inner delicate parts of the bud from the inclement weather, but I am unable to see that insects are of any advantage to the plant when so caught. The dry bud scales are sticky for a purpose which we can readily understand. The flies are most likely accidentally caught. Possibly this is the case with some other plants which catch insects by a sticky secretion or other contrivance. I have lately given some attention to the *Martynia* on account of the great numbers of small insects which it catches by glandular hairs. On August 3d I counted seventy-six small Diptera and some other insects on the upper side of a young leaf of about four inches average diameter, and two hundred on the under side. The insects are caught on all parts of the plant which are exposed, on the stems, on the calyx and corolla, including even the throat of the corolla. Among a lot of others was one plant about three feet high, spreading three feet in diameter, which according to estimate had seven thousand two hundred small flies on it at one time. The hairs are very numerous all over the surface. None of them are sensitive, as I can find. They vary exceedingly in length, from three sixteenths of an inch to one one-hundredth or even shorter. Some of them have as many as ten cross partitions. The contents of these cells appear quite clear, except one near the top, next to the top cell. This is larger than several of those below, and contains chlorophyll. It seems to be something like a gland. Above this is a larger cell, with perpendicular striæa along its sides. When fresh and undisturbed the top is nearly spherical and resembles a small drop of dew. The secretion is quite copious and exceedingly viscid, with an unpleasant odor. I placed some small fragments of raw beef on the glands one morning, but the sun seemed to dry them up, much as it did those left on blades of grass which had no glands. I placed some very minute portions on the glands in a spot sheltered from the direct rays of the sun. In some cases the whole of the piece of beef disappeared.

The small insects seem to live but a short time, although they are touched by only two to four hairs. The substance seems to be soon taken out of the insects. In my opinion, it is a true insectivorous plant. (Proceedings Amer. Assoc. Adv. Sc., 1875.)

A CENTURY'S PROGRESS IN AMERICAN ZOÖLOGY.

BY A. S. PACKARD, JR.

THE title of this article is almost a misnomer, since American zoölogical science dates only from 1796, when Barton published his Memoir on the Fascination attributed to the Rattlesnake, while his Facts, Observations, and Conjectures on the Generation of the Opossum appeared in 1801. These were simply memoirs, but still talented productions and not unworthy to begin the century. Previous to this, John Bartram published a few zoölogical tracts in the Philosophical Transactions of the Royal Society of London, the first appearing in 1744, while his Description of East Florida, etc., was published in London in 1769.

John Bartram was born in this country, and so was Barton; but the latter was, perhaps, the more genuine biologist, and his work was so well appreciated in England that he was called by Swainson the "father of natural history in America." The first century of American zoölogy should, then, date from 1796, and it had a worthy beginning.

American systematic zoölogy may be said to date from the years 1808–14, when the successive volumes of Wilson's Ornithology were published, though it should be remembered that Wilson was born and bred in Scotland. Thus, with the exception of Bartram's and Barton's works, what we have to say of American zoölogy (including animal physiology and psychology and embryology) covers only a little over half a century.

The next work was by Prince Bonaparte, on birds, a volume complementary to Wilson's great work, and published in this country in 1825–33.

But the first general work by a native-born American was Dr. Richard Harlan's Fauna Americana, published in 1825. This was succeeded by Dr. John D. Godman's work on North American Mammals, published in three volumes in 1826–28. Bartram,[1]

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[1] John Bartram was born at Darby, in the suburbs of Philadelphia.

Barton, and Harlan were born in Philadelphia and taught anatomy there. Godman was born in Annapolis, and lectured on anatomy in three medical colleges, but not in Philadelphia. On the whole, American zoölogy took its rise and was fostered chiefly in Philadelphia by the professors in the medical schools; and zoölogy the world over may be said to have sprung from the study of human anatomy, as taught at the anatomical centres of Italy, France, England, and Germany.

The last half-century of progress in zoölogy in America may be divided into three epochs: —

(1.) The epoch of Systematic Zoölogy, during which a few physiological essays appeared. To this department of zoölogy a most decided impulse was given by the Smithsonian Institution, which went into active operation in 1847, while the study of the fossil forms (palæontology) was greatly accelerated by the influence of national and especially state surveys.

(2.) The epoch of Morphological and Embryological Zoölogy. This period is due to the arrival of Louis Agassiz in this country, in 1846, resulting in his lectures on comparative embryology and the foundation of the Museum of Comparative Zoölogy, where American students, who were attracted by the fame of Agassiz, were instructed in the methods of Cuvier, Von Baer, Döllinger, and Agassiz himself, and zoölogy was studied from the side of histology and embryology, while palæontology was wedded to the study of living animals.

(3.) The epoch of Evolution, or the study of the genetic relationship of animals, based on their mutual relations and their physical environment. This period dates from the publication of Darwin's Origin of Species, in 1859.

Turning, now, to the first epoch, — that in which American systematic zoölogy took its rise, — we find that work was done which must necessarily precede more important studies on the embryology, geographical distribution, mutual relations, and psychology of animals, and which exerts a marked influence on the classification of animals, which nowadays is equivalent to tracing their genetic relationships; for the time is past when the animal world should be regarded as comprised within separate sub-kingdoms, between which there is no morphological or genetic connection.

The systematic works are so well known and our space so limited that we shall merely enumerate the names of our chief zoölogical authors. In the study of mammals the works of Audubon and his predecessors, already named, and of Thomas Jefferson, T. Say, J. Bachmann, G. Ord, S. F. Baird, T. Gill, Harrison Allen, J. A. Allen, E. D. Cope, Elliott Coues, J. Y. Scammon, B. G. Wilder, and W. S. Barnard, should be mentioned, with the palæontological essays of R. Harlan, J. C. Warren, J. Leidy, Cope, and O. C. Marsh, together with Godman's Rambles of a Naturalist and L. H. Morgan's work on the beaver, and physiological essays by J. Wyman, S. Weir Mitchell, J. C. Dalton, and others.

The ornithological works of Wilson, Bonaparte, Audubon, Nuttall, Baird, Cassin, and Coues, the more recent great work of Baird, Brewer, and Ridgway, Coues's Birds of the Northwest, and the many descriptive and biological papers of other authors, such as T. M. Brewer, Ord, J. P. Giraud, J. K. Townsend, A. L. Heerman, G. N. Lawrence, H. W. Gambel, J. Xanthus, H. W. Henshaw, H. Bryant, S. Cabot, T. M. Trippe, C. J. Maynard, and others, with the papers on distribution by Baird, A. E. Verrill, Allen, and R. Ridgway, together with those on fossil birds by Marsh and Cope, are all worthy of comparison with the best European works and papers.

The reptiles and amphibians have been described by Harlan J. E. Holbrook, T. Say, J. Green, Baird, C. Girard, E. Hallowell, L. R. Gibbes, C. A. Lesueur, J. E. LeConte, L. Agassiz, and Cope, and an entire assemblage of forms in the western Cretaceous and Tertiary formations has been discovered by Leidy, Marsh, and Cope. The anatomy of the nervous system of *Rana pipiens*, by Jeffries Wyman, is a classic, as are the researches of S. Weir Mitchell upon the Venom of the Rattlesnake and the Researches on the Anatomy and Physiology of Respiration in the Chelonia by S. Weir Mitchell and G. R. Morehouse.

The fishes of North America have been worked up by S. L. Mitchell, Lesueur, C. S. Rafinesque, D. H. Storer, J. E. Dekay, Holbrook, Agassiz, Girard, J. P. Kirtland, J. C. Brevoort, Wyman, Baird, Gill, Cope, W. O. Ayres, F. W. Putnam, T. G. Tellkampf, D. S. Jordan, H. C. Yarrow, C. C. Abbott, G. B. Goode, R. Bliss, S. W. Garman, and others; while the fossil forms have been described by J. H. and W. C. Redfield, Leidy, R. W. Gibbes, J. S. Newberry, Cope, and O. St. John.

In entomology the writings of Say, the two LeContes, F. E. Melsheimer, N. Hentz, T. W. Harris, S. S. Haldeman, R. von Osten Sacken, B. Clemens, J. D. Dana, G. Horn, S. H. Scudder, P. R. Uhler, H. Hagen, B. D. Walsh, A. S. Packard, Jr.,

A. R. Grote, W. H. Edwards, Henry Edwards, Sumichrast, H. C. Wood, A. Fitch, C. V. Riley, E. Norton, J. H. Emerton, C. Thomas, B. P. Mann, and others, are in most cases quite voluminous, though mostly descriptive, while the fossil forms have been described by Dana, Scudder, Meek and Worthen, S. I. Smith, and O. Harger. Their anatomy has been studied by Leidy, Scudder, and Packard.

The great work of Dana on the Crustacea of the United States Exploring Expedition placed him next to Milne-Edwards at the head of living authors in this department, and his essay on their geographical distribution is the starting-point for all such inquiries. In this connection should be noticed the essays of Dana on cephalization in animals, suggested in the first place by his studies on the Crustacea. The North American species have been described by Say, W. Stimpson, J. W. Randall, L. R. Gibbes, S. I. Smith, Hagen, Packard, and O. Harger, and the fossil forms by Green, Hall, Billings, Stimpson, and others.

The intestinal and higher worms have been worked up by D. Weinland, Girard, Leidy, Wyman, Stimpson, and Verrill; and of the aberrant classes, the Polyzoa have been carefully studied anatomically by A. Hyatt, the Brachiopoda by E. S. Morse and W. H. Dall, and several species of Tunicata described by C. A. Lesueur, Tellkampf, Louis and A. Agassiz, Verrill, and Packard; while their development has been studied by Morse.

The Molluscs of North America have been elaborated by Say, Gould, Lesueur, Rafinesque, Haldeman, I. Lea, T. A. Conrad, C. B. Adams, Stimpson, the two Binneys, J. W. Mighels, J. P. Couthouy, E. Ingersoll, A. Agassiz, T. Bland, T. Prime, Morse, J. Lewis, Dall, Tryon, Verrill, R. E. C. Stearns, Sanderson Smith, and others. The fossil Mollusca of entire formations have been described by Hall, Billings (of Canada), F. B. Meek, C. A. White, F. S. Holmes, O. St. John, C. F. Hartt, R. Rathbun, O. A. Derby, Whitfield, N. S. Shaler, Whiteaves (of Canada), and other palæontologists, and the quaternary species studied by Holmes, Dawson, Stimpson, Packard, Verrill, Matthews, and others. Their anatomy has been studied by Leidy, Wyman, Morse, Dall, and W. K. Brooks.

The Radiates (including the Cœlenterates and Echinoderms) have been carefully elaborated by Louis and A. Agassiz, and by Say, Stimpson, E. Desor, Ayres, Macrady, H. J. Clark, T. Lyman, and Verrill; while Dana's elaborate report on the Zoöphytes of the United States Exploring Expedition took the nighest rank among systematic works. Numerous fossil forms have been brought to light by Hall, Billings, Meek, Shumard, White, Whitfield, W. H. Niles, O. A. Derby, and other palæontologists, and the distribution of the recent forms on both sides of the continent has been studied by Verrill and A. Agassiz.

The Sponges have been chiefly studied by Clark and Hyatt; and the Protozoa by J. W. Bailey, Clark, Leidy, and Tuttle.

We may congratulate ourselves on the high position of our palæontologists in the scientific world. The labors of James Hall, Meek, Billings, Dawson (of Montreal; we have included Canadian students in this article), and others have revealed whole platforms of life in the Palæozoic rocks; while the researches of Leidy, Marsh, and Cope in the Tertiary and Cretaceous beds of New Jersey and the West, and of Deane, Hitchcock, Leidy, Wyman, Newberry, Emmons, and Cope in Triassic and Carboniferous strata, have been productive of valuable results.

The discovery of the fossil bird-like reptiles of New Jersey, by Leidy and Cope; of birds with teeth and pterodactyls without teeth; of lemur-like monkeys, by Marsh; and the discovery by Leidy, Marsh, and Cope of connecting links between living ruminants and hog-like forms, and between elephants and tapirs; together with the genealogy of the horse, and the increase in the size of the brain of living forms over their Tertiary ancestors, as elaborated by Marsh, all present a mass of new facts bearing on the evolution of life on the American continent and the general doctrine of evolution.

In philosophical zoölogy Dana's papers on Cephalization, and Wyman's views on the Vertebrate Theory of the Skull, in his memoir on *Rana pipiens*, and his studies on antero-posterior symmetry in vertebrates; those of James Hall on the succession of molluscan life in palæozoic rocks; and those of Agassiz on prophetic and synthetic types, and laws of embryological growth as correlated with the succession of extinct forms, with other views in his Essay on Classification, should be here cited. The deep-sea researches of L. F. de Pourtales on the coast of Florida enabled him to state that "animal life exists at great depths in as great a diversity and as great an abundance as in shallow water." This was in 1867, before the cruise of the English steamer Porcupine and the researches of Carpenter, Thompson, and Jeffreys.

The epoch of embryology or the developmental study of animals was inaugurated by Agassiz in 1846. In the publication of his Contributions to the Natural History of the United States, mainly devoted to the developmental history of the radiates and turtles, Agassiz was assisted by H. J. Clark, who, under his training, became the best histologist our country has yet produced. W. J. Burnett, another histologist, was only inferior to Clark. Macrady, another of Agassiz's students, published some papers of importance on the Acalephs and their mode of development. Desor and Girard wrote on the embryology of worms. Memoirs of a high order of merit followed, from the pen and pencil of Mr. Alexander Agassiz. His embryology of the Echinoderms appeared between 1864 and 1874; the memoir on the Alternation of Generations of the worm, *Autolycus*, appeared in 1862; his paper on the early stages of Annelids in 1866; his remarkable memoir on the transformation of *Tornaria* into *Balanoglossus* was published in 1873; and his elaborate embryology of the Ctenophores in 1874. In 1864, Jeffries Wyman, at the time of his death our leading American comparative anatomist and physiologist, published a memoir on the development of the skate. The beautiful memoir of Hyatt on the embryology of Ammonites was a difficult research, while the brilliant papers of Morse on the early stages of the Brachiopod, *Terebratulina*, published in 1869–73, enabled him, by embryological as well as anatomical evidence, to transfer the Brachiopods from the Mollusca to the vicinity of the Annelidan worms. His studies on the carpus and tarsus of embryo birds should also be mentioned. In 1872 Packard published a memoir on the development of Limulus, and pointed out the affinities of its young to certain young Trilobites; and he also published papers on the embryology of the Thysanourous, Neuropterous, Coleopterous, and Hymenopterous insects. S. I. Smith traced the metamorphoses of certain crabs and shrimps. Several entomologists, as Harris, L. Agassiz, Fitch, Riley, Scudder, Packard, LeBaron, Hagen, Cabot, Walsh, Saunders, Edwards, and others, have studied the metamorphoses of insects, while the drawings in illustration of Abbot and Smith's Natural History of the Rarer Insects of Georgia were made by Abbot, who lived several years in Georgia. In 1874 Emerton described the embryology of the spider, *Pholcus*, and during the present year an important memoir by W. K. Brooks on the anomalous mode of development of *Salpa*, a Tunicate, has appeared. We may, then, take an honest pride in the embryological work done by American students; for in this department great activity was shown when scarcely anything was being done in England or France, and the United States have been for twenty-five years past only second in embryological studies to Germany, the mother of developmental zoölogy.

Of anthropological authors, we have room only to speak of Morton, Davis, E. G. Squier, Pickering, L. H. Morgan, Agassiz, Nott and Gliddon, Wyman, J. D. Whitney, Foster, Jones, Abbott, Berendt, Leidy, Baird, Dall, Putnam, C. A. White, Rau, Gillman, Meigs, Jackson, Barber, and a number of men now in the field, chiefly of aboriginal archæology.

The third or evolutional epoch produced an original and distinctively American school of evolutionists. Hyatt's memoir On the Parallelism between the Different Stages of Life in the Individual and those in the Entire Group of the Molluscous Order, Tetrabranchiata, was published in 1867, and several papers extending his views to other groups of Ammonites and Mollusks have appeared since then. Cope's Origin of Genera was published in 1868, and his paper On the Method of Creation of Organic Types, in 1871. Hyatt's views essentially agreed with those published by Cope, but were less general in their application. The theories of both authors are based mainly on the embryological and post-embryonic changes of animals, and on the idea that the different degrees of acceleration and retardation of the growth of the individual are paralleled by those of genera, families, orders, and classes. This hypothesis attempts to account for the origin of the different groups of animals, and, we believe, will lead to a more general and fundamental doctrine than natural selection. As Cope observes, the law of natural selection "has been epitomized by Spencer as the 'survival of the fittest.' This neat expression, no doubt, covers the case; but it leaves the origin of the fittest entirely untouched," and he accordingly seeks for the causes of the origin of the fittest. Here also should be mentioned the writings of Baird, Allen, and Ridgway on the laws of geographical distribution and climatic variation in mammals and birds, which have revolutionized our nomenclature in these classes, and bear directly on the evolution hypothesis. Special attempts to ascertain the probable ancestry of living American mammals have been made by Gill, Cope, and Marsh; of cephalopod mollusks, by Hyatt; of insects, by Packard; and of brachiopod worms, by Morse.

Contributions to the doctrine of natural selection have been made by Dr. W. C. Wells, Rafinesque, Haldeman, Walsh, Riley, Morse, Brooks, and others.

Such has been the progress of zoölogy in the United States within less than a century. Its future progress will in part depend on the attention paid to it by medical students, to whom we may look for treatises on histology and embryology. At present there are no histologists in the United States who have published special monographs. When professorships of zoölogy alone are established in our colleges (at present mineralogy, botany, zoölogy, and geology are often taught by a single person) competent science-teachers will arise for our higher schools, and the science, we may hope, will be cultivated with something of the thoroughness of the German methods. At present we are not so greatly behind France and England as we were twenty years ago. There is, however, danger that Russia will outstrip us, and we are about on a level with the Scandinavians and the Dutch.

With our energy and native ability, and the aid of well-endowed colleges and museums, we may hope hereafter to compete even with Germany. The development of any branch of science is largely dependent on individual students, and every opportunity should be afforded young men of promise of devoting their time to original research. Specialists are sadly wanted in a country like ours, where the tendency is, perhaps, rather to the production of mediocrity than of genius.

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THE MISSING LINK BETWEEN THE VERTEBRATES AND INVERTEBRATES.[1]

THE views which Dr. Dohrn has recently put forth, as to the details of the steps by which the vertebrate stock arose out of an ancestry not very much unlike the existing Annelids, are of such interest that, notwithstanding previous reference to the subject, no apology is needed for presenting the readers of *Nature* with a condensation of the main argument contained in The Origin of Vertebrata.

Dr. Dohrn first draws attention to the correspondences between vertebrate and insect embryos, which have been too little regarded in consequence of our designating the nervous side in the one as dorsal, in the other as ventral. Yet the facts that, in both, the nervous system is developed on the convex side of the embryo and acquires a strong convex flexure anteriorly, and that the body-cavity is finally closed up on the side of the body opposite to the nervous system, point to a common origin at a comparatively high level. The surface of the animal which is called ventral is determined by the presence of the mouth on that surface; and if any vertebrates had a mouth-opening between the brain and the spinal cord on the dorsal surface, that dorsal surface would necessarily become ventral. Since, moreover, the ancestors of the vertebrata must have had a nervous ring surrounding their gullet, it would appear more reasonable to suppose that the mouth-opening had been changed in the course of development than that the situation of the nervous centres had been altered. We are thus led to look for traces of an old mouth-opening on that surface of the early vertebrates which corresponded to our dorsal surface, and to seek reasons for regarding our present mouth as a comparatively modern development.

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[1] Der Ursprung der Wirbelthiere und das Princip des Functionwechsels: Genealogische Skizzen. Von Anton Dohrn. (Leipzig: Engelmann.)

Dr. Dohrn believes that the old mouth passed through the nervous centres between the crura cerebelli, or, more accurately, in the fossa rhomboidea, or fourth ventricle, which is remarkable for being of greater proportionate size early in development, and afterwards undergoing retrogression. At an early stage we only need to conceive a slit to be made in the nerve tube at the bottom of the fossa rhomboidea, in order to furnish a suitable passage into the alimentary canal. His first reason for regarding the vertebrate mouth as a modern structure is that it arises so extraordinarily late in development. The embryonic body is almost completely framed, all the great systems are established, the circulation is in active operation, while as yet there is no mouth. Again, the mouth does not arise in the position in which it permanently remains in the great majority. It undergoes considerable shifting forwards. Only in the Selachians and Ganoids does it retain its primitive situation. Moreover, the study of development is steadily tending to establish the idea that the mouth of vertebrates is homodynamous with the gill-clefts. It is limited, like them, by a pair of arches, lies just in front of the first pair of gill-clefts, arises simultaneously with them in the embryo, and opens into the alimentary canal. A glance at the ventral surface of a Ray shows the likeness of the mouth to a pair of coalesced gill-clefts. Consequently, it becomes probable that the present mouth-opening once existed and functioned as a gill-cleft; that at a certain period in the ascending development, both the old and the new mouths supplied nourishment, that the latter gained the predominance, and that finally the old mouth became aborted.

The next problem attacked is the origin of the gill-clefts. A very elaborate account is given of the supposed process by which the external gills and segmental organs of Annelids were metamorphosed into the gills and gill-clefts of vertebrates and the skeletal elements connected with them. The great difficulty which Dr. Dohrn confesses in this matter is the connection of the inner extremities of the segmental organs with the wall of the alimentary canal. But if this be granted it is comparatively easy to understand how the shortening and widening of the segmental organs might give rise to gill-cavities such as those of the Selachians. The process by which Dr. Dohrn conceives that the limbs of vertebrata might have been developed from two pairs of gills in Annelids is a greater evidence of ingenuity, though it is to be expected that it will be viewed rather incredulously.

It follows from the view of the origin of vertebrates thus expounded that Amphioxus loses much of its interest, for there is no place for Amphioxus among Annelids, nor among the primordial vertebrates; it lacks almost all that they possess. Yet nothing can be gained by excluding Amphioxus from the vertebrates; for it is so connected with the cyclostome fishes that it cannot be placed at any great distance from them; while on the other hand it is so related to Ascidians that the latter must be included among the vertebrata.

Dr. Dohrn then proceeds with a long argument to show that the cyclostome fishes are degenerate from a higher type of fishes, and that Amphioxus is a result of still further degeneration. He shows how their mode of life necessitates many of the modifications they have undergone, and that the diversities of the details of structure in cyclostomes are inconsistent with their being viewed as representing stages in upward development. Finally, the larva of Ascidians is represented as a degenerate fish — a degenerate cyclostome, possibly — which carries to the extreme all the departures of the latter from the fish-type. The most important element in this degeneration results from the fact that Ascidians, instead of being attached to fishes or to any objects from which they can derive nutriment, are fixed to stones, plants, etc., or to such parts of animals (cephalo-thorax of crabs, tubes of tubicolous annelids) as do not afford them nourishment. Consequently they have lost the old mouth in the organ of attachment, homologous with that of all vertebrates, and have developed a new one, homologous with the nasal passage of *Myxine*. Thus we can explain the astonishing fact that the mouth-opening of the Ascidian larva has a communication with the fore-wall of the so-called cerebral vesicle. It is the last vestige of the openings in the nasal sacs by which the olfactory nerves entered.

The most patent objection to Dr. Dohrn's view about Amphioxus is that it fails to account for the development of a many-segmented respiratory apparatus as a degeneration from a higher animal with a small number of gill-arches. It would appear far more reasonable to suppose Amphioxus to be a degeneration from a much lower elevation than the cyclostome type, namely, from some stage where the respiratory apparatus retained the multiserial character derived from its Annelid forefathers.

The key-note of the author's reasonings is to be found in the principle of transformation of function (*Functionswechsel*), on which he lays great stress. He states it as follows: The transformation of an organ happens through a succession of functions being discharged by one and the same organ. Each function is a resultant of several components, of which one constitutes the chief or primary function, while the others are lower or secondary functions. Diminution of the importance of the chief function with increase of the importance of a secondary function alters the entire resultant function; the secondary gradually rises to be the chief function, the resultant function becomes different, and the consequence of the whole process is the transformation of the organ. This principle is considered to be a complete answer to the difficulty so strongly insisted on by Mr. Mivart, the incompetency of natural selection to account for the incipient stages of subsequently useful structures. Dr. Dohrn's statement of his principle does not strike us as very different from Mr. Darwin's (Origin of Species, fifth edition, page 251), though a little more definitely stated. Mr. Darwin says, "The same organ having performed simultaneously very different functions, and then having been in part or in whole specialized for one function; and two distinct organs having performed at the same time the same function, the one having been perfected whilst aided by the other, must often have largely facilitated transitions." The illustrations given by Dr. Dohrn of the steps by which the anterior extremities of crustacea became applied to mastication, how the mouth of vertebrates originated from a pair of gill-clefts, how the respiratory apparatus of tunicates originated from that of vertebrates, etc., are, however, exceedingly interesting.

An English translation of Dr. Dohrn's pamphlet could not fail to be serviceable to the large number of students who take an interest in the genealogical problems of morphology. — G. T. BETTANY, in *Nature.*

A COSMOPOLITAN BUTTERFLY. II. ITS HISTORY.

BY SAMUEL H. SCUDDER.

NOTWITHSTANDING the ubiquity and general abundance of *Vanessa cardui*, its natural history is imperfectly known. Of its life in the tropics there is no published statement beyond the brief account given by the indefatigable Horsfield; he simply mentions that in Java the caterpillar feeds on a species of *Artemisia*, the native name of which is *Godomollo*, and that the butterfly appears in December. Just beyond the tropics, at the Cape of Good Hope, Trimen reports it as found in the imago state throughout the year, but most abundant from September to March. At about an equal distance north of the tropics, on the same continent, in Egypt, this butterfly flies through the winter, and from November to March caterpillars in almost every stage may be found upon a species of *Malva*, called by the Arabs *Mlukheh*, while the thistles growing abundantly by the railway lines are untouched. These fragments comprise the account of this butterfly outside of Europe and North America, and the following remarks are confined to this insect as it exists in north temperate regions.

In New England this butterfly is double-brooded and hibernates in the imago state.[1] The hibernating butterflies do not usually begin to emerge from their winter quarters until the middle of May, and badly worn specimens continue to fly until after the middle of June. They lay their eggs during the latter half of May and early in June; these hatch in from six to eight days, and the caterpillars therefrom become fully grown between the middle of June and the middle of July; the chrysalids hang from eight to fourteen days, and disclose the first fresh butterflies about the 10th of July. These usually become abundant by the middle of the month, and at the end of the third week innumerable; they continue to emerge from the chrysalis until the early days of August, and fly until the next brood appear; these lay their eggs during the last of July and first of August, and the caterpillars undergo their final transformations in the latter half of August and early in September, the autumn brood of butterflies first appearing late in August and continuing on the wing until the end of October, when they hibernate.

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[1] At least so far as is known. In Europe, according to some writers, it often passes the winter in the chrysalis state; but authorities do not agree upon this point.

This account does not correspond with the history of the same insect in Europe. Meyer-Dür states that in Switzerland the butterfly may be seen on the wing from April to the end of June (wintered specimens), and from the middle of August until late in October; that is, it is single-brooded. Many authors speak of it as double-brooded, without mentioning the specific times at which it may be found; while others give the same seasons as Meyer-Dür and call it double-brooded, mistaking the double apparition of the same brood (winter intervening) for distinct broods. My own observations in the neighborhood of Geneva and Paris lead also to the conclusion that the insect is single-brooded; and no entomologist, to my recollection, has given the best proof of digoneutism, namely, two distinctly separated dates for the apparition of the caterpillar. Nevertheless, from the time of Ochsenheimer, who repeatedly says, "Ich habe zwei Generationen bemerkt," different authors have claimed for this insect a double brood; and until direct observation shall have determined the point, it should be considered, at least for some parts of Europe, an open question. In Switzerland and in England all observers seem to agree that it is single-brooded; and this is in direct contrast to the digoneutism of the same insect in New England.

If this were a solitary fact, it would possess comparatively little interest. But if we compare the annual histories of the dozen or two butterflies either actually occurring both in Europe and in Eastern North America, or represented on either continent by intimately allied forms, — if we compare their histories, we shall find several other species which present similar peculiarities, and be led to believe that the case of *V. cardui* is only one illustration of a somewhat general law.

The European *Aglais urticæ*, for example, is generally double-brooded; occasionally a triple brood is mentioned; it is one of the commonest of European butterflies, and reaches from the North Cape to the Mediterranean; our congeneric *A. Milberti* is rarely found south of the northernmost parts of the United States, and yet is triple-brooded in all parts of Canada. *Everes Amyntas*, again, occurs throughout Europe, with the exception of certain northern and northwestern portions, and is double-brooded; our *E. Comyntas*, named for the resemblance to its European congener, and by some careless authors considered identical with it, is also a wide-spread insect; but even in New England, which is toward the northern limit of its range, it is triple-brooded. The wide-spread European blues, *Argus* and *Aegon*, are usually placed among monogoneutic insects, and the latter certainly has but a single brood in England (where it is the only one of the two found); Meyer-Dür is in fact almost the only author who claims these species as digoneutic; both of them occur in Southern Europe; the American *Scudderii*, closely allied to these and an insect hardly known south of the Canadian border, is double-brooded. Our *Pontia Protodice* is triple-brooded, and the European *P. Daplidice* only double-brooded, while our common species of *Eurymus*, *E. Philodice* and *E. Eurytheme*, are triple-brooded in the north (perhaps polygoneutic farther south), and the closely allied European species only single or double brooded.

But the most striking example of all will be found in the species of the genus *Iphiclides*. The European *I. Podalirius* is confined to the Mediterranean region, while our *I. Ajax* belongs to the southern half of the United States; the regions are therefore fairly comparable; yet we can find no mention of more than two broods of *I. Podalirius*, while Mr. Edwards has shown that, even as far north as the Appalachian valleys of West Virginia, *I. Ajax* has four and sometimes five generations during the year; moreover, the first of these generations is dimorphic, and the dimorphism has in it the semblance of a seasonal character, the earlier individuals being of one type and the later of another.

These cases might perhaps be multiplied, but further positive evidence is not at hand; it should be remarked, however, that there is no reversal of this rule; among all the butterflies properly comparable on the two continents, there is no single instance where the European butterfly has more broods than the American.

This result of a comparison of the annual histories of similar European and American butterflies furnishes but another instance of that intensity which seems to characterize all life in America. The expenditure of nervous and vital energy, against which physicians vainly inveigh, which superannuates our merchants, lawyers, clergymen, and other professional men, is not induced by the simple passion for gain, place, power, or knowledge, but by an uncontrollable restlessness, a constant dissatisfaction with present attainments, which marks us as a hurrying, energetic, enterprising people. My own experience has been that studies of precisely the same nature and undertaken under similar external conditions are accompanied by a very different mental state on the two continents. In Europe we are content to plod industriously on, unconscious of the need of relaxation; in America we bend with nervous intensity to our work, and carry the same excitement into the relaxation which such a life inevitably demands. After a long absence in Europe, a keen observer may even be directly conscious of this quickened life.

Now to what shall we ascribe such peculiarities in animal life? Naturally we look to climatic influences, and our attention is first attracted by the well-known fact that, if we compare two places in Europe and America having the same mean annual temperature, the extremes of variation will prove much greater on this side of the Atlantic. For example, while the mean annual temperature of New York is about the same as that of Frankfort, the summer temperature of the former is that of Rome, and its winter that of St. Petersburgh. Moreover, the changes from summer to winter and from winter to summer are more immediate in America, or, in other words, the summers and winters are longer (by about three weeks). Such long and hot summers are of course favorable to the multiplication of broods in butterflies whose history allows a repetition of the same cycle more than once a year; the length of the winter is of slight consequence, as long as the insects can survive it; and it can have no influence upon the number of broods, unless there be species (of which we know nothing) able to resist a cold winter only in certain stages of existence, and a multiplication of whose broods might require some pliability in this respect. Not only, too, are our summers longer and hotter, but they enjoy a marked preponderance of sunshine, as compared with European summers; and this alone would almost seem capable of producing the variation we have noticed in the number of broods.

Differences will be found in all other climatic phenomena of the two continents. "From Europe as a standard," says Blodgett,[1] "the American climate is singularly extreme both in temperature, humidity, quantity of rain, winds, and cloudiness or sensible humidity. The oscillations of the conditions are greater, and they vibrate through long measures above and below the average. All the irregular as well as regular changes are of this sort, and the European observer defines the climate as directly antagonistic to that he has left." These differences, however, as Humboldt and others long ago pointed out, have a broader bearing than the above statements alone would imply; for they are characteristic of the eastern shores of both worlds as opposed to the western, the meteorological phenomena of the eastern United States being almost precisely paralleled by those of Northern China, where great excesses of temperature occur, with wide variability, long summers and winters, and rapid transitions.

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[1] Climatology of the United States, page 221.

Perhaps on these grounds we can most simply account for the difference in the number of broods in certain butterflies on the two continents; but, if so, then it follows that we ought to anticipate similar differences between the broods of some of the species found both in Europe and in Eastern Asia; a point of which we can assert absolutely nothing, for want of data. These grounds, however, will certainly be insufficient to account for the differences to which we have alluded in man; for what contrast could well be greater than that existing between the national character of the Chinese and that of the Americans! We are rather forced to believe that the causes of the distinctions between the European and the American, if these are at all due to physical agencies, must chiefly be sought elsewhere. From my slight knowledge of the climatic features of Eastern Asia, it is impossible to contrast Eastern North America with the north temperate regions of the Old World, taken as a whole; certainly the greater frequency and intensity of electrical phenomena on our shores may have some influence.

But to return to the history of our cosmopolitan butterfly. We have traced the sequence of events in its life; let us now look more closely at some of the habits peculiar to it in either the earlier or the later stages of its existence. The ovipositing female alights upon a plant and moves about with trembling wings, and body generally on a line with the midrib, until it finds a spot to its taste; the wings, elevated at an angle of about forty degrees with each other, now become quiet, the tip of the abdomen is bent down upon the leaf, and the egg is instantly laid. I observed one butterfly alight many consecutive times on unopened thistle-heads, thrusting her abdomen between the spines to the very sepals, as if in act of ovipositing; but no egg was laid until she alighted on a leaf. The same butterfly appears never to lay more than a single egg upon one leaf, although she frequently deposits eggs on different leaves of the same plant, and in one particular instance laid them upon cut leaves lying on the ground; in this case she laid them upon the uppermost surface, whichever way the leaf was turned; on the plant they are always laid upon the upper surface; and I once found an egg on a spinous hair of a thistle leaf. Several eggs may sometimes be found on the same leaf, but they will always hatch at different times, showing that they were laid on different occasions, if not by different individuals. The eggs themselves vary considerably, their vertical ribs ranging from fourteen to nineteen, and averaging fifteen and a half or sixteen in number; judging from the examination of forty or fifty specimens, it would seem as if the average were slightly greater in America than in Europe.

The caterpillar feeds principally on *Compositæ* and especially upon the tribe of *Cynareæ*, or thistles. In our country it has been found on *Cnicus benedictus*, *Cirsium lanceolatum* (the common thistle), *C. arvense*, *Carduus nutans*, *Silybum Marianum*, *Onopordum acanthium*, and *Lappa major* (burdock), — all plants introduced from Europe; also on *Senecio cineraria*, belonging to another tribe of *Compositæ;* on another of the *Compositæ*, one of the sunflowers, *Helianthus sp.*; on *Althæa rosea* (garden hollyhock), — again an introduced plant, and one of the *Malvaceæ;* and it is reported (perhaps by mistake for its congener, *V. Atalanta*) to have been found on the nettle. Möschler remarks that he has received neither thistles nor nettles from Labrador, and wonders upon what the caterpillar may feed in that inhospitable region. In Europe it has been taken upon various species of *Carduus*, *Cirsium*, and *Onopordum*, and other *Cynareæ*, such as *Centaurea benedicta* and *Cynara Scolymas;* some *Senecionidæ*, such as *Achillea millefolium* and *Gnaphalium arvense;*[1] on *Echium*, one of the *Borraginaceæ*, and on *Malva rotundifolia*. It seems to prefer the *Malva* in Egypt, being found abundantly on the species cultivated by the Arabs for medicinal purposes; and since this is cut at various times during the winter, myriads of the caterpillar are doubtless annually exterminated.

The young caterpillar makes its escape from the egg, as usual among lepidopterous larvæ, by biting a slit almost around the crown of the egg, and pushing up this improvised lid; it does not appear to devour the egg-shell, as caterpillars usually do, but, after biting a few little holes partly through the upper surface of the leaf, makes its way to the opposite side and takes up a position, each one apart from its fellow, either between the midrib and curled-up rim if near the tip of the thistle leaf, or next the midrib or a lateral rib, if farther back; here it bites away the silken film and makes a nest, covering itself with a slight open web, into which it weaves the bitten particles of the film. From this retreat it sallies forth to eat irregular patches in the parenchyma, which it often partially covers with an extension of the web.

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[1] Horsfield, as we have seen, raised it in Java on *Artemisia*.

Each caterpillar, when it has outgrown this confined abode, builds for itself a separate nest, generally near the summit of a stalk; it spins a thin web on the surface of the leaf, near the edge, if it be a broad-leaved plant, and then draws over a portion of the leaf by means of threads, completing the covering with a silken tent; when half grown it forsakes this and forms a more perfect nest, drawing together leaves, buds, and bitten fragments by the same process, so as to form an oval cavity, about thirty-five millimetres long vertically, and a little more than half as broad. The narrow, irregular, crisped, and rather distant leaves of the thistle, on which it is most frequently found, cannot, however, be made to cover even a single caterpillar, and the spaces are closed by a thin open web, through which the inmate can readily be seen, but which is sufficiently close to retain all the rejectamenta of the caterpillar. The nest is usually covered, at least in the upper half, with spines of the plant, evidently bitten off for the purpose; there is an opening in the nest, near or at the summit, just large enough to allow the larva to emerge, apparently made by eating away the web. The leaves which penetrate the nest are not lined with silk, but the web is frequently stretched across the inequalities of the leaf. Within this habitation the larva rests with its head downward, like its congener, *V. Atalanta;* but, unlike it, when its earlier stages are passed, it feeds upon the upper surface and parenchyma of the leaf, without touching the under cuticle, and when these are consumed, it crawls out to seek its fortune and weave a more commodious mansion; when, however, it has reached its final stage, it devours the entire leaf.

When about to undergo its transformation, the caterpillar does not wander far, and frequently remains upon the plant which has nourished it. A specimen bred in confinement, but which had abundance of room, formed of partially dried leaves, connected by open, angular, irregular, silken meshes, averaging about four millimetres long, a sort of cocoon, of no definite shape, but larger than its previous nest, and which it attached to the top of the cage.

The butterfly is particularly fond of fields, gardens, highways, open ground, and waste places; it frequently alights on stone walls heated by the sun, and is greatly attracted by flowers, particularly by thistles and the other plants upon which the caterpillar feeds; here it may readily be taken; not so in other spots, for although very fearless, and even impudent, it is exceedingly wary, dashing off headlong at the slightest alarm. In Florida, Dr. Chapman once found three or four entangled in the leaves of a Sarracenia.

Its flight is rapid, dashing, and discontinuous, it doubles frequently and abruptly, usually to the right or left rather than up or down, although it has no predilection for a particular elevation above the ground, as some other butterflies have; in these frequent changes it makes a series of spasmodic efforts, the movements of the wings being more vigorous during the initial half of each start, or perhaps confined to that period. It loves to return to the spot from which it has been driven, or to the immediate vicinity, often circling about first, as if selecting the best spot. On a windy day its flight is not a little remarkable; it rises high in the air, then suddenly darts down until it has approached within five or ten metres of the ground, when it starts upward again to repeat the process. On a warm, sunny day, it frequently flies until within half an hour of sunset, and it may be seen laying eggs at almost any hour between ten and four.

"Its wildly timorous behavior," says Meyer-Dür, "is quite striking; it is uncommonly audacious; swift and savage, it dashes irregularly about; scarcely observing the pursuer, heedless of the net, it returns directly to the place it has left, and sits with horizontally opened wings on the dry earth or spots of sand. It is a nimble, lively, youthful, untamed, petulant insect, which shows in its behavior no resemblance to its proud but circumspect neighbor, *Atalanta.*"

On alighting, it partially or wholly expands the wings; when fully spread, they are brought well forward, and are often even slightly depressed; the straight antennæ are then spread at an angle of ninety degrees and lie in the plane of the body, or perhaps slightly elevated.

Although its habit is to alight freqently, its flight is strong and well sustained. Trimen relates that a specimen flew on board a vessel in which he was sailing, when about ninety miles from Teneriffe. Reference has already been made to one of these butterflies visiting a vessel six hundred miles from the main land during a cyclone, and other similar though not so striking instances might be added. Several accounts have also been given of the migration or simultaneous movement of this insect in swarms. Dr. Hagen records two instances;[1] on October 26, 1827, Prevost saw such a moving swarm, composed of a stream of butterflies from ten to fifteen feet broad, passing from south to north for two hours. On April 26, 1851, Ghiliani saw, near Turin, a great flight of these insects; according to Bouquet,[2] the day was fine, after continued rain, and a strong breeze blew from the west; commencing at eleven A. M., the swarm came from the south-southeast and continued with a precipitate flight for five hours towards the north-northwest.

"In England and on the continent of Europe," says Trimen,[3] "*cardui* sometimes appears in great abundance, and then, perhaps for several seasons, will be uncertain in appearance and restricted to particular localities. I have not heard of this irregularity of appearance being noticed in other parts of the world." This is, however, the universal testimony of observers in America, and is probably due to the action of parasites. It was one of the first phenomena that drew my especial attention to butterflies. This butterfly, indeed, is one of the best subjects of study for those who wish to investigate the causes of irregular apparition; and only such as spend much time in the field can hope to solve the problem. A close observation of the comparative abundance of the butterfly for several consecutive years in the same locality, accompanied by an attempt to rear hundreds of the caterpillars (selecting only those which are nearly full grown, and recording the proportion of healthy and infested ones), will probably show whether the attack of parasites is a *vera causa.*

As regards the parasites, Prof. A. E. Verrill has reared from caterpillars of this insect a species of *Microgaster* called *M. fructuosus* by Cresson. Mr. Riley has also bred a dipterous parasite: its larva usually issues from the victim while the latter is in the caterpillar state, though sometimes not until it has transformed to chrysalis; and in one instance the *Vanessa* completed its metamorphoses with the parasitic fly yet in its abdomen; it did not, however, properly expand its wings. Mr. Riley has also bred *Ichneumon rufiventris* Brullé from this insect; this hymenopteron issues from the anterior extremity of the chrysalis, infested specimens of which may always be recognized by their pale color. In Europe, the caterpillar is infested by the larvæ of a *Microgaster;* parasites reared by me perforated the skin of the caterpillar August 19th and made their cocoon on its body. September 4th the box containing the cocoons was opened, disclosing both dead and living imagines; they belonged to two distinct species, those of the smaller being dead and dry, while those of the larger were either living or recently dead; on the succeeding day the remainder of the larger ones appeared, and proved to be, as identified by my friend Mr. Drewsen, of Copenhagen, *Microgaster subcompletus* var.? von Esenb., and the smaller an undetermined species of the same genus, probably undescribed. Of the former 3♂ and 15♀ emerged; of the latter 8♂ 3♀; besides these, four larvæ had been taken from their cocoons and preserved in that state; all of these came from the body of a single caterpillar. The larger species is probably the actual parasite of *V. cardui;* the latter, a parasite of the parasite.

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[1] Stett. Entom. Zeit., xxii. 80.

[2] Annales Soc. Ent. Fr. [2] ix. Bull., 56.

[3] Rhop. Afr. Austr., 121.

AQUARIA: THEIR PAST, PRESENT, AND FUTURE.

BY WILLIAM ALFORD LLOYD.

EIGHTY-SIX years ago — in the year 1790 — there might have been seen trudging along the streets of Edinburgh an "old blue-coated serving-man," carrying an earthenware pitcher or jar, of three or four gallons' capacity That pitcher contained sea-water for the marine aquarium of Sir John Graham Dalyell, Bart., who thus employed a man, or probably a succession of men, from the time he began aquarium-keeping till he finished at his death in 1851, a period of sixty-one years. The jar was sent to the sea to be filled twice or thrice weekly; but averaging it at five times a fortnight, and allowing four miles for each double journey from Great King Street to the sea and back, that amounted to 39,650 miles from the year 1790 to the year 1850, which was an enormous and perfectly needless expenditure of force, expressed in time and money, even although the results of Sir John's investigations were given to the world in five such important quarto volumes as his Rare and Remarkable Animals of Scotland, 1847–48; and his Powers of the Creator displayed in the Creation, 1851–58.

Dalyell's mode of operation, as told to me by his sister Elizabeth, in two letters dated 1860, and printed in the *Zoölogist* of

November, 1873, vol. viii., second series, pp. 2757, 2758, was as follows: He kept his living marine animals, consisting of the lower kinds below fishes, in a number of glass cylindrical jars, of various sizes and proportions, and with usually one animal in each. The water in these jars he changed every morning, "often twice a day, if he perceived the smallest fragment amongst it, wiping and washing the glasses very clean." He then drew away the water so used, and replenished it from the earthenware jar with the water got from the sea. At one time I should not have termed this aquarium-keeping at all, because of the change of water. (See Crystal Palace Aquarium Handbook, 1875, p. 7.) But now, having got to think more broadly, I recognize this, not as a change of water in the sense of its being lost, but merely as a change of position from a house in Edinburgh to the sea, and back again. That is to say, the water he dismissed from his jars went into a gutter in a street, or into a sewer below it, and found its way by gravitation into the ocean again. Or, if it were poured on the ground, into which it soaked, it found its way back to the sea by an infinitely more circuitous route. But had Dalyell been more of a general philosophical thinker as well as a naturalist, he would have saved himself this very great amount of cost and trouble. Had he but reflected on that which was then known, namely, that water — both sea-water and fresh water — is practically indestructible, and that any decaying organic matter, animal or vegetable, or both mixed, can be got rid of, and the water be left pure, then he would have saved his servants their weary walks of more than as far, in their aggregation, as twice round the world, nearly.

In the ocean, of course, various animals and plants are incessantly dying in large numbers, and their decomposing remains are prevented from permanently poisoning the water, in which other animals live and breathe, by the incessant motion to which the sea is subjected, and this motion brings the water into purifying contact with the atmospheric air which everywhere exists. It is this air, or rather the oxygen in it, which the water takes up in greater quantity than the nitrogen, which is another and larger component of the atmosphere, which is the source of purification alluded to, the water being merely a medium or a vehicle for the exhibition of the oxygen. In addition to this, vegetation grows by the action of light, and decomposes the poisonous carbonic acid gas evolved by the breathing of animals, the carbon being used to form the woody substance of the plants, and the residual oxygen being liberated for the use and benefit of the animals. Thus the ocean, and rivers, and lakes, and all other waters in nature, of varying degrees of freshness and saltness, by motion and vegetation, both originating from the sun, are maintained sufficiently pure and respirable.

These operations were going on almost at Dalyell's door, yet he did not learn to apply them to practice, as he might have done. What he did was this: He fed the animals in his jars on mussel flesh, which is easily diffusible in water, and which quickly makes it milky; and this, with the absence of growing vegetation, and the breathing and other emanations of the animals, soon caused the water to become offensive in appearance and in smell. So he threw it away. But the very act of pouring it, and the motion of it as it trickled onward to the sea, purified it, because such an act was an unconscious imitation of what nature does. Had Sir John but thought of the merely vehicle character of water, and of its incapability of being decomposed save by a very slow and expensive process, he would at once have seen that the minutely disseminated mussel flesh and its juices in the water made that water unfit to support life, only temporarily. It was not the water itself that was not fit; it was only something in the water that was wrong, and if that something were removed the water would be left as good as ever. If, therefore, instead of sending it back into the sea by a long road, and then going to the immense pains to dip it back again, he had poured it into a large receptacle in his own house, such receptacle or reservoir being many times larger than the aggregate contents of all his glass jars, he would have found that in a short time he would have possessed a source of supply for the jars quite as good as the ocean provided. Had he, in addition, placed his reservoir in a cool cellar, and had a pipe connecting it with the study to which Miss Dalyell has incidentally alluded, with a funnel at the upper end of the pipe, in which was placed a piece of straining-cloth or a small hair-sieve, to arrest the coarser pieces of decaying organisms, and if he had poured the water he had used into this funnel, the arrangement would have been still better. Yet better would it have been had he possessed another pipe leading upward from the reservoir, through which he could pump up the sea-water as he wanted it. Best of all would have been some form of incessantly-working machinery, by means of which the water would be always coming up, day and night, from this large and cool reservoir into the experimental glasses, for then they would have been constantly kept at an even temperature and in a state of constant aeration. This would have done away with the necessity of the everlasting wiping and washing of the glasses; and, they being thus left alone, and in a certain amount of daylight, vegetation would soon have appeared in them, stimulated by the action of that light, without having been visibly introduced, but present everywhere in the seeds or spores of plants, merely waiting to be developed. Such an arrangement, indeed, would have been precisely that of the best modern aquaria as now made, in which the water is so continually and abundantly aerated by ceaselessly moving machinery that impurities have no time to accumulate, but are oxygenated and dissipated as quickly as they form. In the Brighton and Havre public aquaria, the old and intermittent system used by Dalyell has been reverted to, and of course with ill results, as the water freshly obtained from the sea is turbid when seen in large masses, and is unhealthy for the animals, only a small number of which therefore can be kept in great bulks of fluid, because it is insufficiently aerated. This will be the case also at the Scarborough aquarium, now being built on the same erroneous principle.

Dalyell, however, was no mechanician or physicist, and he knew nothing of marine botany; so he just did as his neighbors did with their fresh-water gold-fish globes; he changed the sea-water and threw it away as quickly as it became sullied, and this water he obtained at no great cost, he living close to the sea. Or if the cost of time in getting it was considerable in proportion to the work done, *i. e.*, the quantity obtained, it mattered not much to him, as he was a rich man. Yet, had he but known it, the sea-water he thus obtained was less good for the animals he kept than it should have been, inasmuch as it was from the adjoining Firth of Forth, and of the density of but 1.024, at a temperature of 60° F.; whereas had he kept it for some months, it would have evaporated to the more proper density of 1.027 at 60° F., taking distilled water as being 1.000 at 60° F.

I have given this narration as showing the state of things aquarially at the end of the last century, and during the first half of the present one, and also as being the mode of operation which the general public, and even the great mass of the higher and better educated classes of society, still believe to be the system necessary to be followed in the maintenance of aquaria.

In the year 1842, the late Dr. N. B. Ward published the first edition of his book, in 8vo, on the growth of plants in closely glazed cases, and this in 1854 was followed by the second edition, in 12mo. In 1853, Dr. N. B. Ward's son, the present Dr. Stephen H. Ward, gave a lecture on this subject at the Royal Institution, which was published as a 12mo pamphlet in the same year. All three of these are now and have been long out of print, and they bear testimony, indubitably, that N. B. Ward experimented with aquaria about the year 1840, though he did not use the word "aquarium," which was employed for the first time in print, as far as I know, twice by Mr. P. H. Gosse, in his Devonshire Coast, post 8vo, 1853, at pages 234 and 441. That is to say, N. B. Ward is the earliest recorded person who *intentionally* arranged together certain animals and plants in water, so that these two sets of organisms should mutually and partly support each other, the plants giving off oxygen and taking up carbon, and the animals taking up oxygen and giving off carbon, thus decomposing and rendering harmless the carbonic acid gas as continually as it was evolved by the animals, and maintaining the water pure. In Dr. S. H. Ward's pamphlet, just named, is a long, circumstantial, and most interesting narrative of how Mrs. Anne Thynne did the same thing precisely with sea-water and marine animals and plants. This lady being in London in the year 1846, and having some living corals and sponges, used to send occasionally to the coast for supplies of water for her creatures. But finding that if a quantity of this water were taken up in a jug and let fall again from its spout in a slender stream, it lost whatever impurity it contained from contact with air in this much comminuted state, she ceased to get more from the sea, and instead got from thence some living sea-weed and placed it in the water, which derived additional benefit from this vegetation, just as Dr. N. B. Ward found his fresh water had benefited by the plants he introduced. It is more than probable, however, that in both these instances the really beneficial vegetation was not that which was thus visibly introduced, but was the minute kind which grew parasitically on the plants and upon the inside of the vessels. Yet it must be admitted that this gentleman and this lady are the two first known persons who, keeping a chemical law in view, deliberately and purposely set about attaining means for its fulfillment in an aquarium.

In 1849, the late Mr. Robert Warington, chemist to the Company of Apothecaries, set up in his rooms, in the hall of that company, in London, his first aquarium, a fresh-water one, followed, in 1851–52, by his first marine aquarium. These he described in the periodicals of the day, and also in a lecture which he gave at the Royal Institution, in an interesting manner, and naturally from a chemist's point of view. At about the same period Mr. P. H. Gosse commenced his earliest marine aquarium, as did Dr. J. S. Bowerbank, Dr. Cotton, and the late Dr. E. Lankester, and the successes attained by these experimenters induced the Zoölogical Society of London to determine to have a public aquarium in its gardens in Regent's Park. The building for this purpose was erected in the spring and summer of the year 1852. The marine and fresh-water animals were begun to be introduced in the late autumn; the following winter and spring were wisely spent in experimenting on the best modes of operating, and the exhibition was opened on May 21, 1853. After having been noticed in print by the *Athenæum* of some months earlier, it was again commented upon by that journal of May 28th, and by the *Illustrated London News* of the same day and year, the latter publication giving views of two tanks. One of the earliest services which this institution conferred on biological literature may be seen in portions of the natural history division of the English Cyclopædia (an adaptation of the earlier Penny Cyclopædia), as the former publication appeared fortnightly, commencing in the spring of 1853; and as it was edited by Dr. E. Lankester, who always took much interest in aquaria, he mentions in the book from time to time that such and such animals named had been kept in this Regent's Park aquarium, to which he gave the needlessly long name of "aquavivarium." This place was my own much loved and earliest place of natural history studies, and in August, 1853, I too arranged a little domestic aquarium of my own — a fresh-water one. Later in the same year I set up a small marine one, or rather a series of little aquaria in glass jars, holding from half a pint to a pint each. Seldom has a student begun with such very small means as I then possessed, for my sea-water was compounded of salts purchased at a London chemist's shop, and my animals were such little sea-anemones as I could find uninjured on oyster shells thrown into London streets. I was in earnest, however, and the difficulties I was so closely beset with, and they alone, enabled me to gain subsequent success. In the earlier books on aquaria — notably in Mr. Gosse's two volumes, his Devonshire Coast and his Aquarium (the latter having gone through two editions, 1853 and 1856, besides a recent reprint without the plates, which have been accidentally destroyed) — aquaria are associated in idea with conservatories, especially as to the growth of plants in each. This notion was very natural. Accordingly the Regent's Park Aquarium was made virtually as a conservatory. But it was a diametrically wrong notion, as the first summer proved; and the second summer (1854) showed this still more conclusively; and the third (1855) yet more so, the evil being an accumulating one. It was then remembered, when too late, that marine and fresh-water plants and animals live in seas and rivers, where the temperature is much more restricted in range than that which obtains in the atmosphere.

It was seen that success was to be obtained by representing these conditions of nature just named, and that to place such organisms in a glass house, where the rays of a summer's sun heated a mass of imprisoned air, was to kill the animals and to stimulate the plants to unnatural growth, or rather to cause them and some of the animals to be covered with a parasitic growth of the lower green algæ, which obscured them. The errors of this earliest aquarium were strikingly shown by its solitary merit, the latter being its fresh-water division, occupying one side of the building, where the water coursed through the tanks in a constant stream, it being clear and cool, and peopled with an adequate number of healthy animals; while on the other side of the building, and in its centre, were the marine tanks, in which the water was, and still is, turbid and warm, and sparsely inhabited by not healthy creatures.

These good results were, however, obtained by accident and not design. The society possessed already a steam-engine, which pumped up water for the general use of its gardens, and it was a mere matter of course to connect the aquarium with this engine, and allow the water (which *chanced* to be drawn from a pure source) to run through the fish tanks, and then be applied to ordinary purposes, drinking or other, for which its passage through the tanks in no way unfitted it. I reasoned with the society that if the sea-water tanks were similarly treated on some such system as the fresh-water series, a correspondingly good result would be attained; and I pointed out that the same law governed both, because in the centre of the building were some isolated fresh-water tanks having no stream in them, and these were in a similarly ill condition as the marine tanks by their side. In reply, the society answered that a circulatory system did exist in a part of the sea-water series, but that it was almost useless; and I then pointed out that that was because the reservoir into which the sea-water entered after it had run through the show-tanks was too small in relation to the dimensions of the latter, and that the reservoir should be several times greater than the show-tanks. My reasoning was all in vain, however, for the society went on throwing away the sea-water when it was only *temporarily* unfitted for use, and getting at a cost of several hundreds of pounds yearly a weekly supply from the sea, especially when soon afterwards another evil made its appearance, consisting of a greenish-brown dense opacity, permeating the water and quite hiding from view all it contained. This was caused by excess of light, for I found that darkness removed it and made the water clear again; and this led to Mr. E. Edward's invention of the dark-chambered tank, a modification of which is now, or should be, employed in all public aquaria where adequate results are aimed at and attained. So, at this early period, 1853–62, though in theory the Zoölogical Society of London, and every one else who maintained aquaria, used the same unchanged water, especially sea-water, yet most persons sent to the sea, or to dealers, of which I was then one, for occasional new supplies. However, from 1853 to 1855, when I could not possibly get new sea-water for my little jars, I merely increased the quantity of water to about eight or ten times as much as those jars collectively held. Thus the aggregate contents of my jars were about six or eight pints; and in a now historical earthenware foot-pan, kept dark in a cool corner at hand, I had five or six gallons more water, containing neither animals nor plants, and when aught occurred to disturb the equilibrium of life in these jars, either from excess of light or heat by standing on a light window-sill, or from excess of food, or from there being too many animals in a small space, instead of throwing away the water thus *temporarily* rendered unfit to sustain life, I merely restored it to a right condition by pouring the contents of these jars into the foot-pan, which was so large in relation to the dimension of the jars that I could immediately dip them up full from it (the foot-pan) without the water being perceptibly the worse for it, especially when I so contrived matters that these transfers were made, not in one day, but on successive days. Thus, in London, far from the sea, which I had never seen, I was so far, aquarially speaking, as well off as the wealthy Sir John Graham Dalyell, with the ocean almost at his door. Later on, in 1857–58, I set up another marine aquarium, in which the show-tank held twenty gallons, and the reservoir five hundred gallons of water, in which that water, instead of being intermittently circulating, as in my jar and foot-pan arrangement, circulated constantly, day and night, by means of a pump and pipes, in a cool underground London cellar or kitchen, with a uniform temperature of about 60° F. This answered excellently, especially when I increased the water in the reservoir to one thousand gallons.

As the more air there is in the water the better it is, hence the value of large and therefore cool reservoirs. Independently of all this, however, the larger the bulk of water, and the more constant and vigorous the circulation and aeration, the less it will be sullied by the animals which live in it. In the Crystal Palace Aquarium we have in the show-tanks twenty thousand gallons of sea-water, and in the reservoir one hundred thousand gallons, total one hundred and twenty thousand gallons, supplied by Mr. W. Hudson in 1870. Yet in this comparatively small quantity of unchanged fluid we have, from September, 1871 to March 31, 1876 (four and a half years), given to the animals in it the following enormous quantity of food without the water being otherwise than always sparklingly clear: —

1. Sandhoppers (*Talitrus*), in pounds weight	12
2. Shrimps (*Crangon*), in quarts	4735
3. Crabs (*Carcinus*), in gallons	137
" (*Cancer*), large, " numbers	1450
4. Scallops (*Pecten*) large, in numbers	32
5. Oysters (*Ostrea*) " "	2195
6. Cockles (*Cardium*), in gallons	18
7. Mussels (*Mytilus*) "	3544
8. Whelks (*Buccinum*) { in gallons	7
" numbers	100
9. Fish, chiefly Whiting (*Gadus*), in pounds weight	3159
10. Smelts' roe (*Osmerus*) " "	14
11. Green sea-weed (*Ulva*), purchased "	400
12. " " (*Conferva*), grown in tanks, quantity unknown.	

And, in addition, we obtain occasional and unrecorded supplies from neighboring fishmongers when the regular supply runs short. Of this animal food, all but the denominations nine and ten are kept alive in a series of reserve tanks till the moment of being eaten. Scarcely any uneaten food, and never any excrement, is manually removed; but all which is not consumed by the animals is chemically dissipated, without filtering, by the enormous volumes of air constantly being injected into every tank by Leete Edwards and Norman's machinery, the speed of which is accelerated (*i. e.*, the oxygenation is quickened) when the water is slightly turbid from an excess of organic matter. All this I have explained more at length in the Official Handbook to the Crystal Palace Aquarium, and in Observations on Public Aquaria, both published at the Crystal Palace. It is this power of oxygenating, or consuming, or burning, at a low temperature, termed by Baron Liebig "eremacausis,"[1] which expresses the real work done in an aquarium, and the force necessary to do that work. Even our thick beds of sand and shingle at the bottom of each tank are so fully charged with air that one thrust of a stick will release a pint of it in bubbles. This is a source of purification and health quite unknown till recently. Consequently the floors of our tanks (excepting the sea anemone tanks) are as speckless and as free from the blackness caused by sulphureted and carbureted hydrogen gas, as on the day they were laid down in 1870. If we have an excessive growth of sea-weeds anywhere, we turn in a shoal of gray mullet (*Mugil capito*), which nibble it down close, like sheep in a field of grass. This leads me to say that at present we do not know how to grow the higher marine algæ, the red, the brown, or even the green kinds, at will. Sometimes I succeed, but always by chance, not knowing why.

Of the general influence of aquaria on zoölogy we have curious evidence in Mr. Gosse's most excellent Manual of Marine Zoölogy for the British Isles, published in two volumes, in 1855–56, in which the author enumerates 1785 species, from sponges to fishes, and of which he figures 779 genera, always preferring to draw from living animals whenever possible. Now, as at that period a larger number of aquarium animals had passed through his hands than through those of any other person, he may be presumed to have, up to then, seen more of them alive than any one else. Yet he enumerates only 201 as having been drawn from life, as he avowedly preferred doing, and of these but a dozen were fishes, others being, for the most part, small creatures, or those which are easily maintained and do not need large tanks and elaborate machinery. But during the twenty years which have elapsed since 1856 I have seen and handled and had under my care, in England, France, and Germany, about 433 species of British marine animals, of which 112 were fishes.

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[1] From the Greek "to remove by burning, or by fire." The words "caustic" and "cautery" have the same derivation.

There are few things more trying to that great virtue, patience, than a large public aquarium, especially in its preparation, before it is ready for the reception of animals. It is to this lack of patience on the part of the directors of the Royal Westminster Aquarium, and to their absolute refusal to allow me to have proper engineering assistance during its construction, and to general mismanagement, that its present confused state, and its unsatisfactory condition in every way, is due. On this account I resigned my post of adviser to the society, as I found it useless to advise when advice was recklessly disregarded. Aquarium work, being hydraulic engineering on a small scale, is essentially the work of an engineer, and not that of an architect, unless he is also an engineer and a mathematician. There is for aquaria a great and important future, both as regards their influence on science and as pecuniary speculations, if indeed, as I much doubt, there can be any real severing of these two interests. Success, however, must always be the result of a careful study and representation of what nature does, and of a strict avoidance of the recent heresies to which I have in this communication adverted. — *Popular Science Review.*

RECENT LITERATURE.

TWO YEARS IN CALIFORNIA.[1] — This book contains apparently a reliable and useful account of California, its scenic and climatic features, its people, with hints for tourists and settlers, and a candid chapter on the Chinese in California. The authoress gives these people credit for a business sagacity, fidelity, industry, and economy which render them a desirable class of immigrants. By their aid, it is claimed, the natural wealth of California has been advanced beyond what it would otherwise have been by a quarter of a century. The literary execution of the book is not rarely capable of improvement, but the work is the result of an honest attempt to impart the fruits of close observation during a two years' residence in California.

COOK'S MANUAL OF THE APIARY.[2] — A cheap and reliable manual of bee-keeping has been needed by amateurs and beginners in the art, and here we have in print Professor Cook's lectures on the subject, delivered annually to his students, forming a guide which we can unhesitatingly commend as sufficiently scientific and practical. The Italian variety is recommended as greatly superior to the German. As regards the treatment of foul brood, we would inquire whether carbolic acid or other disinfectants would not prevent the spread of this contagious disease. The description of the queen bee is excellent. Though she has a sting, she can seldom be induced to make use of it. Says our author, "I have often tried to provoke a queen's anger, but never with any evidence of success." Professor Cook adopts the prevalent opinion that the queen's development is conditioned by the richer quality and greater quantity of her food, "perhaps aided by a more ample habitation." We would here inquire whether the temperature of the queen's cell differs from that of the drone or worker cells, in fact, whether temperature as well as richer and more abundant food is not a factor in the production of queens; and, on the other hand, what brings about the production of workers, of which, we are told in this manual, there are from twenty thousand to forty thousand in every good colony. If some one would offer a prize for the best essay on the causes of retardation in the worker bee, and of acceleration in the queen, and another prize for the best essay on parthenogenesis in the honey bee, since the matter is by no means exhausted, he would confer a favor on the public and aid in the advance of physiology. Meanwhile we look to our agricultural stations and colleges for original work in this direction.

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[1] *Two Years in California.* By MARY CONE. With Illustrations. Chicago: S. C. Griggs & Co. 1876. 12mo, pp. 238. $1.75.

[2] *Manual of the Apiary.* By A. J. COOK. Lansing, Mich. 1876. 8vo, pp. 59.

WHEELER'S GEOLOGY OF THE UNITED STATES WEST OF THE ONE HUNDREDTH MERIDIAN.[1] — This bulky volume gives the results of several years' work by the survey in portions of our western Territories. It embraces reports by Mr. G. K. Gilbert on portions of Nevada, Utah, California, and Arizona explored in 1871 and 1872, already noticed in this journal, with a second on portions of New Mexico and Arizona explored in 1873. The late Mr. A. R. Marvine contributes a chapter on the geology of the route from Saint George, Utah, to Gila River, Arizona; and there are reports on the geology of certain parts of Utah, Nevada, Arizona, and New Mexico, by Mr. E. G. Howell; on a portion of Colorado surveyed in 1873, by Mr. J. J. Stevenson, and a mineralogical and agricultural report, by Dr. O. Loew. The heliotype plates add much to the general interest of the work.

APPALACHIA.[2] — This is the organ of the Appalachian Mountain Club, devoted to the exploration of the mountains of the Eastern States, particularly the White Mountains of New Hampshire, which gives evidence of vigor by the publication of the first number of its journal within a few weeks after its fifth meeting. It contains, besides other matter, a number of papers of interest to tourists and geographical students, under the following titles: Atlantic System of Mountains, by Prof. C. H. Hitchcock; A Day on Tripyramid, by Prof. C. E. Fay; Two New Forms of Mountain Barometer, by S. W. Holman; New Map of the White Mountains, by J. B. Henck, Jr.; East Branch of the Pemigewasset, by W. Upham.

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[1] *Report upon Geographical and Geological Explorations and Surveys west of the One Hundredth Meridian, in charge of Lieutenant G. M. Wheeelr, U. S. Engineers.* III. Geology. Washington. 1875. 4to, pp. 681. With 13 plates and cuts.

[2] *Appalachia.* Vol. i., No. 1. June, 1876. Boston: A. Williams & Co. Published for the Appalachian Mountain Club. 8vo, pp. 62. 50 cents.

ARCHIVES OF THE NATIONAL MUSEUM OF BRAZIL.[1] — The first number of this new journal, established by the national museum recently founded at Rio Janeiro, contains several memoirs, among them one on the aboriginal remains in the shell-heaps of Southern Brazil, locally called "sambaquis," by Professor Wiener, and illustrated by two plates. Professor Hartt, in charge of the Geological Survey of Brazil, and director of the department of physical science and geology in the national museum, contributes an illustrated article of much interest on Brazilian pottery.

MANTON'S TAXIDERMY.[2] — Though fifty cents is a large price for this little book, and the illustrations consist of three rude diagrams, it is yet sufficiently explicit to enable one to learn how to stuff a bird or mammal if he is unable to take a few lessons from a teacher.

RECENT BOOKS AND PAMPHLETS. — The Preparation and Mounting of Microscopic Objects. By Thomas Davis. Second edition, greatly enlarged. Edited by John Matthews. New York: G. P. Putnam's Sons. 1876. 12mo, pp. 214. $1.25.

Bulletin of the United States Geological and Geographical Survey of the Territories. Vol. ii., No. 4. Washington, D. C. August 4, 1876. 8vo.

Force of Ciliary Motion. By H. P. Bowditch, M. D. (Reprinted from the Boston Medical and Surgical Journal.) Cambridge. 1876. 8vo, pp. 5.

Check-List of the Noctuidæ of America, North of Mexico. II. By A. R. Grote. Buffalo. 1876. 8vo, pp. 20. 75 cents.

Synopsis Cecidomyidarum. Von J. E. von Bergenstamm und P. Löw. Wien. 1876. 8vo, pp. 104.

Beiträge zur Anatomie und Histologie der Pflanzenlaüse, insbesondere der Cocciden. Von E. L. Mark. Bonn. 1876. 8vo, pp. 59.

On the Growth of the Flower-Stalk of the Hyacinth. By A. W. Bennett. Preliminary Note on the Rate of Growth of the Female Flower-Stalk of *Vallisneria spiralis.* (Extracted from the Transactions of the Linnæan Society of London.) 1876.

Micro-Photographs in Histology, Normal and Pathological. 4to. By C. Seiler, M. D., in conjunction with J. Gibbons Hunt, M. D., and J. G. Richardson, M. D. Philadelphia: J. H. Coates & Co.

An Address on Some of the Leading Public Health Questions, etc. By J. M. Toner, M. D. Cambridge, Mass. 8vo, pp. 40.

Ueber die Befruchtung der Nordamerikanischen Yucca-Arten. Von J. Boll. 8vo, pp. 4.

GENERAL NOTES.

BOTANY.[3]

INFLUENCE OF LIGHT AND HEAT ON TRANSPIRATION IN PLANTS — Professor Wiesner has recently examined this interesting subject and has added a few facts to those already known. He shows that both light and radiant heat favor transpiration, or active evaporation from the surface of plants, but he thinks that the ultra-violet rays have little effect. The well-known fact that green plants transpire more rapidly in the light is explained on the ground of their absorbing the light by means of their chlorophyll, and thereby increasing the tension of the aqueous vapor in the cavities of the plant, and thus favoring its escape. This was studied experimentally by comparison of transpiration of green and of etiolated plants in the light, by researches in the spectrum itself, and by interposing a chlorophyll-solution. The opening of stomata in the light plays only a subordinate part in the increase of transpiration caused by light.

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[1] *Archivos do Museu Nacional do Rio de Janeiro.* Vol. i., No. 1. 1876. 4to, pp. 30. 5 plates.

[2] *Taxidermy without a Teacher.* By WALTER P. MANTON. Illustrated. South Framingham, Mass. 1876. 12mo, pp. 41. 50 cents.

[3] Conducted by PROF. G. L. GOODALE.

INFLUENCE OF TEMPERATURE ON THE GERMINATION OF PINE SEEDS. — Dr. W. Velten states that heating the seeds can exercise upon their germination an effect which is favorable or unfavorable according to their physiological condition; and, further, that the time during which they are heated is an important element, since he finds that a lower temperature for a long time has the same influence as a higher temperature for a proportionally short period.

BOTANY OF CALIFORNIA, VOL. I. — This work gives a systematic account of the Polypetalous and Gamopetalous Exogens of California, of the whole eastern slope of the Sierra Nevada and of the ranges adjacent to it on the east, from Arizona to Northern Nevada, and of Southern Oregon. The Polypetalous orders have been elaborated mainly by Professor Brewer and Mr. Sereno Watson; the Gamopetalæ by Professor Gray. Of the high character of a systematic treatise by the authors just mentioned it is quite unnecessary to speak, but we may be permitted to call attention to a few of the special merits of the present volume. There are two keys, one *analytical*, the other *synoptical*, by which the determination of the order of a plant and its place in the system is rendered very easy. In these days when there can be noted a tendency in some quarters to go back to a false indexical method, which secures by hook or by crook merely the name of a plant, somewhat after the fashion of a pick-lock, it is pleasant to observe so effective a protest in the form of a sound, scientific, and yet most helpful brace of keys.

The selection of the type has been made with great skill. The catchwords of the printed page stand out boldly, so that the eye can hardly fail to detect the object of search. And, lastly, there is a good sprinkling of interesting notes of a popular character throughout the work, and much prominence has been given to an account of the geographical range of the plants. With Gray's Manual, Watson's Botany of the Fortieth Parallel, and this work (soon, we hope, to be completed), the study of the plants with which one meets in his journey across the continent is now an easy task. It should be said that we are indebted to the generosity of a few far-sighted citizens of California for the publication of the first volume of this work, for which their own legislature failed to provide. Now, one good turn deserves another, and as Californians (the legislature of the State perhaps excepted) never do things by halves, we shall hopefully expect to see the other half of this, namely, volume second.

Botanical Papers in Recent Periodicals. — *Comptes rendus*, 82, No. 20. Corenwinder, Chemical Researches respecting Vegetation. (The office of leaves. Fixation of carbon.) No. 21. L. Chailletet, On the Nature of the Mineral Substances assimilated by Fungi. No. 23. Pasteur, On the Origin of Organized Ferments. A. de Candolle, Influence of the Age of a Tree on the Mean Time of Leaf-Bud Expansion. Boiteau, On the Galls occurring on the Leaves of French Grape-Vines. No. 25. Maupas, On Contractile Vacuoles in the Vegetable Kingdom. No. 26. Hartsen, Researches respecting *Cupressus pyramidalis*. Bontin, Note on the Origin of the Nitrates in *Amarantus Blitum*. 83, No. 1. Trécul, The Carpellary Theory illustrated by Amaryllidaceæ. Nylander, The Lichens of Campbell Island. No. 2. Trécul's paper on the carpellary theory continued. Durin, On Cellulosic Fermentation of Cane-Sugar.

Flora, No. 18. Sachs, On Emulsion Figures and the Arrangement of Swarmspores in Water. W. Nylander, Lichens collected by Labalestier in Egypt. Dr. Suerssen, Notices of Vascular Cryptogams collected by Wawza. No. 19. Dr. B. Frank, The Biological Relations of the Thallus of some Crustaceous Lichens. No. 20. Nylander, Additions to European Lichenography. Dr. Prantl, Morphological Studies. De Krempelhuber, Brazilian Lichens. No. 21. J. E. Weiss, Relations of Growth and the Course of Fibrovascular Bundles of Piperaceæ. J. Reinke, Note respecting Recent Account of Apparatus for Demonstrating Growth.

Botanische Zeitung, Nos. 25, 26, 27, 28. Dr. Ernst Reuther, Contributions to the History of the Development of Flowers. No. 29. Solms-Laubach, The Development of the Flowers of *Brugmansia Zippelii* and *Aristolochia Clematitis* L. (continued in the four succeeding numbers of the journal). No. 33. A. W. Eichler, Reply to Reuther's paper mentioned above. No. 34. Professor Schenk, On the Fruit of Fossil Equisetaceæ. Professor Famintzin, On the Formation of Cotyledons.

ZOÖLOGY.

Geographical Variation among North American Mammals, especially in Respect to Size. — Having recently had an opportunity (through the kindness of Professor Baird) of studying with some care the magnificent series of skulls of the North American *Mammalia* belonging to the National Museum (amounting often to eighty or a hundred specimens of a single species), I have been strongly impressed with the different degrees of variability exhibited by the representatives of the species and genera of even the same family. The variation in size, for instance, with latitude, in the wolves and foxes is surprisingly great, amounting in some species (as will be shown later) to twenty-five per cent. of the average size of the species, while in other species of the *Feræ* it is almost *nil.* Contrary to the general supposition, the variation in size among representatives of the same species is not always a decrease with the decrease of the latitude of the locality, but is in some cases exactly the reverse, in some species there being a very considerable and indisputable increase southward. This, for instance, is very markedly true of some species of *Felis* and in *Procyon lotor.* Consequently, the very generally received impression that in North America the species of *Mammalia* diminish in size southward, or with the decrease in the latitude (and altitude) of the locality, requires modification. While such is generally the case, the reverse of this too often occurs, with occasional instances also of a total absence of variation in size with locality, to be considered as forming "the exceptions" necessary to "prove the rule."

That there are such exceptions, among both birds and mammals, I have been long aware, and long since noticed that where there is an actual increase in size to the southward it occurs in species that belong to families or genera that are mainly developed within the tropics, there reaching their maximum development, both in respect to the number of their specific representatives and in respect to the size to which some of the species attain. This fact seems also to have been observed by others.[1]

Most of the mammals of North America belong to families, subfamilies, or genera which have their greatest development in the temperate or colder portions of the northern hemisphere, as the *Cervidæ*, the *Canidæ*, the *Mustelidæ*, the *Sciuridæ* (especially the subfamily *Arctomyinæ*), the *Leporidæ*, the *Castoridæ*, the *Arvicolinæ* among the *Muridæ*, the *Saccomyidæ*, *Geomyidæ*, etc. These rarely present an exception to the general law of decrease in size southward, though the variation is less (in fact, occasionally almost *nil*) in some species than in the others. The more marked exceptions, or those in which there is an actual increase in size southward, occur in those families that reach their highest development within the tropics, as the *Felidæ* and *Procyonidæ*.

In some species (as I have elsewhere noticed) there probably exists a double decadence in size, the individual reaching its maximum dimensions where the conditions of environment are most favorable for the existence of the species, and diminishing in size toward the northern (through scarcity of food and severity of climate) as well as toward the southern (in consequence of the enervating influence of tropical or semitropical conditions) limit of its distribution.

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[1] I find that Mr. Robert Ridgway, some two years since, thus referred to this point. In alluding to the smaller size of Mexican specimens of *Catherpes Mexicanus* as compared with specimens from Colorado (*C. Mexicanus* var. *conspersus*), he says, "As we find this peculiarity exactly paralleled in the *Thryothorus ludovicianus* of the Atlantic States, may not these facts point out a law to the effect that in genera and species in the temperate zone the *increase in size with latitude is toward the region of the highest development of the group?*" (Baird, Brewer, and Ridgway's Birds of North America, vol. iii., App., p. 503, 1874.)

In a general way, the correlation of size with geographical distribution may be formulated in the following propositions:—

(1.) *The maximum physical development of the individual is attained where the conditions of environment are most favorable to the life of the species.* Species being primarily limited in their distribution by climatic conditions, their representatives living at or near either of their respective latitudinal boundaries are more or less unfavorably affected by the influences that finally limit the range of the species. These influences may be the direct effects of too high or too low a temperature, too little or too much humidity, or their indirect effects acting upon the plants or other sources of food. Hence the size of the individual generally correlates with the abundance or scarcity of food. Different species being constitutionally fitted for different climatic conditions, surroundings favorable to one may be very unfavorable to others, even of the same family or genus. Hence

(2.) *The largest species of a group* (genus, subfamily, or family, as the case may be) *are found where the group to which they severally belong reaches its highest development, or where it has what may be termed its centre of distribution.* In other words, species of a given group attain their maximum size where the conditions of existence for the group in question are the most favorable, just as the largest representatives of a species are found where the conditions are most favorable for the existence of the species.

(3.) *The most "typical" or most generalized representatives of a group are found also near its centre of distribution, outlying forms being generally more or less "aberrant" or specialized.*—J. A. Allen, Bulletin U. S. Geological Survey of the Territories.

A Gorilla in England.—Mr. Moore, Curator of the Free Public Museum at Liverpool, sends the following letter to *The London Times* of June 23d:—

"Sir,—A veritable young living gorilla was yesterday brought into Liverpool by the German African Society's Expedition, which arrived by the steamship Loanda, from the West Coast. The animal is a young male, in the most perfect health and condition, and measures nearly three feet in height. Its beetling brows, flattened, podgy nose, black muzzle, small ears, and thick fingers, cleft only to the second joint, distinguish it unmistakably from the chimpanzee. Only one other specimen has been brought alive to England. In the winter of 1855–56 a young female gorilla, of much smaller size, was exhibited by the late Mrs. Wombwell in Liverpool and other places. It died in March, 1856, and was sent to Mr. Waterton, of Walton Hall, who preserved the skin for his own collection, and sent the skeleton to the Leeds Museum. This specimen I saw living in Liverpool and dead at Walton Hall. All subsequent attempts to import the gorilla alive have failed; and, unfortunately, the British public will have no opportunity of profiting by the present success, as the members of the expedition, with commendable patriotism, are taking the animal, on Saturday, *via* Hull to Berlin. Could it have graced our own Zoölogical Gardens it would have been the lion of the day; for, in addition to the great scientific interest of the species, the abounding life, energy, and joyous spirits of this example would have made it a universal favorite. Courteously received at Eberle's Alexandra Hotel by the members of the expedition, I found the creature romping and rolling in full liberty about the private drawing-room, now looking out of the window with all becoming gravity and sedateness as though interested, but not disconcerted, by the busy multitude and novelty without; then bounding rapidly along on knuckles and feet to examine and poke fun at some new-comer; playfully mumbling at his calves, pulling at his beard (a special delight), clinging to his arms, examining his hat (not at all to its improvement), curiously inquisitive as to his umbrella, and so on with visitor after visitor. If he becomes overexcited by the fun, a gentle box on the ear will bring him to order like a child, — like a child, only to be on the romp again immediately. He points with the index finger, claps with his hands, pouts out his tongue, feeds on a mixed diet, decidedly prefers roast meats to boiled, eats strawberries, as I saw, with delicate appreciativeness, is exquisitely clean and mannerly. The palms of his hands and feet are beautifully plump, soft, and black as jet. He has been eight months and a half in the possession of the expedition, has grown some six inches in that time, and is supposed to be between two and three years of age."

EGG OF CHIONIS. — In the final article of Bulletin No. 3 of the National Museum, upon *Chionis minor*, by Dr. Coues and myself, appears (page 89) the following paragraph: —

" An egg of *C. minor* was received by the Zoölogical Society, January 17, 1871, concerning which Prof. Alfred Newton said, 'No egg of either species of this genus had before been known, and this confirms, by its appearance, the systematic position of the form shown by osteology, its affinity, namely, to the plovers.' "

Since on the preceding page there is cited from the *Ibis* a mention of a letter from Mr. Layard, dated at Cape Town in 1867, wherein an egg of this bird had been described, the impression is naturally conveyed that Professor Newton had overlooked this previous description. Such an impression was held by us at the time of writing, and a passing mention thereof was furthermore made by me in an article upon the same subject, which appeared in the *Popular Science Monthly* for March last.

I have since learned that Mr. Layard was misinformed with regard to the authenticity of his specimen, brought him by a whaling captain, and that it proved not to belong to Chionis at all.

A considerable injustice has therefore been unwittingly done Professor Newton, which I beg that you will allow me the opportunity for repairing by giving publicity to this note. — J. H. KIDDER, Surgeon U. S. Navy.

ANTHROPOLOGY.

An African Potter at her Work. — I was much interested in one village (Kisunge) by watching a potter at her work. First she pounded enough earth and water for one pot, with a pestle such as they use in beating corn, till it formed a perfectly homogeneous mass. She then put it either on a flat stone or on the bottom of another, and giving it a dab with her fist in the middle to form a hollow, worked it into a shape roughly with her hands, keeping them constantly wet, and then smoothed out the finger-marks with a corncob, and finally polished it over with one or two bits of gourd and a bit of flat wood, the bit of gourd giving it the proper curves, and finally ornamenting it with a sharp-pointed stick. I went to look at it, wondering how it was to be taken off the stone and the bottom shaped, when lo and behold, it had no bottom! I waited to see what would be done, and after it had been drying four or five hours in a shady place it was stiff enough to be handled carefully, and a bottom worked in of another piece of clay. I timed one from beginning to pound the clay till it was put aside to dry, and it took thirty-five minutes; putting in the bottom might take ten more. This pot would hold from two and a half to three gallons. The shapes of many are very graceful, and all are wonderfully truly formed (like the amphora in Villa Diomed at Pompeii); they are used for palm oil. — *Cameron's Diary, Journal of the Royal Geographical Society.*

GEOGRAPHY AND EXPLORATION.

Exploring Expeditions in Greenland. — In the summer of 1875, Mr. Helland, a Norwegian geologist, visited Greenland and made some exact and consequently very important observations on the rate of movement of the interior ice. His measurements were made at the great Jacobshavn glacier and also at the Itifdliarsuk glacier, at the opening of the Tossukuset Fiord, whence the great harvest of icebergs sweeps down the Waigat.

In April, 1876, Mr. Steenstrup, the eminent geologist, and Lieutenant Holm, a young and enterprising officer of the Royal Danish Navy, sailed for Greenland, according to the *Geographical Magazine*, with the intention of penetrating into the interior. The first attempt will probably be made from the Tunnudliarbik Fiord, near Julianehaab, in the hope of being able to reach a mountain-peak which has been observed in the far distance to pierce the surface of the glacier, and is known as the "Jomfruerne" or "Niviarsiæt." But this will only be preliminary, and the gallant explorers intend to renew their attempts for three or four years, until they succeed. The Danish government has granted the necessary funds for this noble enterprise.

Those interested in arctic research will be glad to hear that Dr. Rink's famous work on Greenland is to be translated into English. This is the most authoritative work on that country, Dr. Rink having been for years Director of Greenland. It will be in one volume, and besides giving a general history of Greenland and its people, will contain an appendix relating to the natural history and meteorology of the country, and will be illustrated by a series of plates (fac-similes of drawings by the Greenland Eskimo, some of which have already found their way into the United States) and a new map.

It appears that the great harvest of white bear-skins is obtained in Greenland from the extreme south, when the bears come on the ice drifted around Cape Farewell in the current from the east coast; that some are taken on the ice round Upernavik in the far north, but that bears are very scarce between Julianehaab and Upernavik. The codfish are mainly taken on the Torske Bank, off Sukkertoppen, and the narwhal horns are entirely from North Greenland.

MICROSCOPY.[1]

MICROSCOPY AT THE AMERICAN ASSOCIATION. — The subsection of microscopy of the American Association for the Advancement of Science, which has hitherto been a transient organization, temporarily formed whenever necessary, was established as a permanent body at the Buffalo meeting in August last. In addition to business connected with the details of organization, nine papers were read, and many interesting discussions were held. Two evenings were occupied, one by an informal *soirée* at the rooms of the subsection, and the other by a very successful reception tendered by the Buffalo Microscopical Club. The members present were cordially and unanimously in favor of the permanent organization. Dr. R. H. Ward, of Troy, was elected chairman for the first year, ending with the Nashville meeting next August. It is earnestly desired and hoped that the microscopists of the country will take such an active interest in the organization as to secure for themselves and others the really great advantages which it offers.

DOUBLE-STAINED MUSCULAR FIBRES. — Dr. Geo. D. Beatty calls attention to the *Lissotriton punctatus* (the smooth-skin newt) and the *Amphiuma tridactylum* as microscopical treasures, the muscular fibres, especially of the tongue, being particularly beautiful, the transverse striæ being very well marked, and the nuclei very large in both species, and greatly elongated in *Amphiuma*, stretching one third across the field with a one-fifth objective and A ocular. The tissues should be double stained for the nuclei with carmine and with picric acid to bring out the transverse striæ. The tissue is hardened by ninety-five per cent. alcohol, followed by absolute alcohol, and sections cut in a section machine or fibres teased out carefully with needles. The sections or threads are placed for one minute in twenty-five per cent. alcohol, soaked for five minutes in Dr. J. J. Woodward's borax-carmine solution, soaked about ten minutes in alcohol acidulated with twenty per cent. of hydrochloric acid until the carmine is nearly removed from all parts except the nuclei, washed in alcohol for a few minutes, the solution being changed until free from acid; then placed for one half to one minute in an alcoholic solution, one twelfth grain to one ounce of picric acid, washed in alcohol, and transferred through absolute alcohol and oil of cloves to balsam for mounting.

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[1] Conducted by DR. R. H. WARD, Troy, N. Y.

PHOTO-MICROGRAPHY. — Dr. Charles Jewett, of Brooklyn, N. Y., has produced extremely perfect photographs of *Amphipleura pellucida* with Tolles's one-fifth immersion objective, B ocular, and Zentmayer's amplifier.

A NEW FUNGUS. — Mr. J. P. Moore has presented to the San Francisco Microscopical Society a specimen and description of a remarkable fungus found growing from a beam in an abandoned drift, four hundred feet below the surface, in the Yellow Jacket Mine, Gold Hill, Nevada. The growth commences as a pure white mycelium bursting out of the wood. The specimen described was three feet four inches long, of a light buff color, and consisted mainly of a three-parted stem, two or three inches in diameter, attached by means of a disk eight or ten inches wide. Towards the other end the stem divided into short branches greatly resembling in shape and arrangement the young antlers of a stag, the three terminal ones being much the most vigorous and conspicuous, forming a perfect trident. The gills are distant, decurrent, notched, and sinuate, and of a pale straw color; the spores ovate or round, exceedingly minute, and borne on true basidia. The plant is called by the miners the lily of the mines; by Mr. Moore, *Agaricus tridens.*

SCIENTIFIC NEWS.

— The Bulletin of the United States Geological and Geographical Survey of the Territories, Vol. ii., No. 4, issued August 4, 1876, contains the following papers: Notes on the Geology of Northeastern New Mexico, by O. St. John. Sexual, Individual, and Geographical Variation in *Leucosticte tephrocotis*, by J. A. Allen. Geographical Variation among North American Mammals, especially in Respect to Size, by J. A. Allen. Descriptions and Illustrations of Fossils from Vancouver's and Sucia Islands and other Northwestern Localities, by F. B. Meek. Note on the new Genus Mintacrinus, by F. B. Meek.

— Advices from Professor Hayden, in charge of the United States Geological Survey of the Territories, state that his parties are all in the field and with orders to finish the work in Colorado and return by November 1st. Professor Hayden has been with one of the parties making an examination of Raton Mountains and San Luis Park so as to perfect the coloring of the geological map.

PROCEEDINGS OF SOCIETIES.

Academy of Natural Sciences, Philadelphia. — June 27th. The meeting was attended by Dom Pedro II., Emperor of Brazil, and his minister plenipotentiary, Senhor A. P. Carvalho de Borges.

Dr. Leidy made a communication upon the structure and life of the Rhizopods. The formation of the shells of the Difflugians was described. and a number of forms were figured.

Professor Cope called attention to certain mammalian remains from the neighborhood of Santa Fé. The specimens exhibited belonged to the *Mastodon productus*, which must have been very abundant in that region. The speaker dwelt upon the peculiarities which distinguished it from *Mastodon Ohioticus*, and gave at length the characters of the dentition.

The three prominent types of mammals from the Eocene, Miocene, and Upper Miocene formations of the West weredescribed and illustrated by fine specimens of skulls of *Loxolophodon cornutus*, *Symborodon acer*, and *S. altirostris*.

Professor Frazer described a collection of microscopic sections of igneous rocks, the peculiarities of which were exhibited by means of the screen and lantern. Certain Brazilian Dolerites were contrasted with others from York County, Pa.

Dr. Horn placed on record a method of distinguishing sexes in the genus *Amblycheila*, depending upon the shape of the trochanters.

July 11th. Mr. Gabb called attention to the use of borax as a substitute for alcohol in the preservation of animal tissues.

July 18th. Mr. Meehan exhibited specimens of *Senecio Jacobæa*, a hardy herbaceous plant which had recently flowered for the first time in fifteen years. He also gave the results of his observations on the mode of fertilization of Campanula, which he believed to be entirely independent of insect agency. The mode of fertilization of the dandelion and chiccory was also described and illustrated. Both of these plants were considered self-fertilizers.

Professor Cope spoke of the species of fossil dogs found in the Santa Fé marl. The vertebrates found in that formation now number thirty-two, including eleven species of Canis. These are all extinct, with the exception of one species of wolf, the *Canis cævis* of Leidy. This was believed to be identical with the living wolf, which was considered to be specifically identical with the common dog. The species mentioned originated in the Upper Miocene and persists to the present day. A new form was described under the name of *Canis Wheelerianus*. The relative size and other characters of the species heretofore described were given.

The number of species of fossil deer found in the formation spoken of was increased from four to six, the two new forms being named

Dicrocerus trilateralis and *Dicrocerus tehuanus.* In answer to Dr. McQuillen, Professor Cope stated that he had at one time supposed that the burrs on certain of the antlers of the fossil deer indicated the seat of fractures, but he had not in all cases been able to find evidence supporting this view. The fact was also pointed out that these antlers had a superficial coating or epidermis which would be sufficient to hold the fractured pieces in place.

ACADEMY OF SCIENCES, St. Louis. — May 15th. Judge Holmes remarked as follows upon man and the elephant in Nebraska. In Dr. Hayden's Annual Report of the United States Geological Survey for the year 1874, recently published, appears the report of Dr. Samuel Aughey on the Loess deposits of Nebraska. It is stated that the Loess covers three fourths of the surface of that State, ranging in thickness from forty to one hundred and fifty feet, and extending westward from the Missouri River to a limit beyond Kearney and the Republican Fork.

The more important fact which he desired to notice was that Dr. Aughey, after some years of careful searching, had succeeded in finding imbedded in this deposit two distinctly-shaped and well-worked arrow-heads, which are figured in his report (page 255). One of them, a small arrow-head, was found at a depth of fifteen feet, at a place three miles east of Sioux City; the other, nearly four times larger, might very well have been a spear-head, and it was found at a place two and a half miles southeast of Omaha, and at a depth of twenty feet, and "thirteen inches above the point where it was found, and within three inches of being on a line with it, in undisturbed Loess, there was a lumbar vertebra of an elephant (*Elephus Americanus*)." The material is not named nor are measurements given. Flint chips are mentioned as found "in the bluffs" in Dakota County, but as not certainly of human origin.

The discovery is important as going to show the contemporaneity of man and the elephant on this continent during the period of the Loess. They must have inhabited together the shores of the great inland seas or expansions of the rivers, in which the Loess formation was deposited. It furnished the first distinct and incontrovertible proof of this fact that he was aware of. Bones of mastodon, elephant, and other extinct animals had been frequently found in the Loess of the Mississippi Valley, but hitherto no human remains had been ascertained with certainty to belong to it. Mr. Worthen, of the Illinois Geological Survey, had reported an instance of arrow-heads being found together with bones of extinct mammalia in an altered drift covered by Loess near Alton; but the circumstances, geologically considered, seemed to admit of some doubt on the question of their cotemporaneousness. But here no room would seem to be left for any other rational hypothesis. Both the arrow-head and the vertebra must have been deposited in the still waters of the lake, or been drifted to the spot by the same moving waters of the Loess period. The arrow-head, certainly, could not have got there if it had belonged to a more recent period. But it is still possible that the vertebra may have been washed out of some older deposit by the action of rivers, and been swept down into the lake; or it may have been frozen into a mass of ice and been carried down by the river, and dropped to the bottom on the melting of the ice. The presence of mastodon bones with the arrow-head, in the Benton County case, has been accounted for in this way: The presence of the arrow-head proved the existence of man in the alluvial period only; but in this instance the arrow-head must have been contemporary with the older Loess deposit, and the bones of mastodon, elephant, and other extinct species of mammalia are so abundant in this deposit, not only in Nebraska but throughout the Mississippi Valley, that no doubt can remain that these animals were also contemporary with the Loess.

In the instances reported by the late Dr. Koch (Tranactions of the St. Louis Academy of Science, i. 61 and 117), of arrow-heads found together with the bones of mastodon, one in the alluvial bottom of the Pomme des Terres River in Benton County, Mo., and the other in the bottom land of the Bourbeuse River, in Gasconade County, Mo., it was possible to explain the facts stated by him as being the result of more recent changes in the local alluvial drift of the river channel. Dr. Wizlizenus (Ibid., page 168) endeavored to account for all the phenomena in this way, and in the latter case by supposing that Indian fires had been built over the spot at a time long subsequent to the deposit of the bones, and the whole afterwards covered by alluvial overflows. He was well acquainted with Dr. Koch, and did not question the veracity of his statements. Judge Holmes had himself assisted Dr. Koch in putting his article into shape for publication in the Transactions, and questioned him minutely as to the particulars stated, and could certify that the circumstances mentioned were positively asserted by him to be true. Nor had he any reason for doubting the truthfulness of Dr. Koch. As lately suggested by Professor J. D. Dana, it is true that Dr. Koch was not a thoroughly scientific and practical geologist, and perhaps he gave some scope to his imagination in the matter of theorizing upon his facts; but he had some experience in such things, and might be allowed to be capable of observing the facts which he stated, however incompetent to apply the requisite tests for a certain conclusion. But the facts observed and reported were not absolutely conclusive of the matter, though carrying much weight of probability.

In this new discovery in Nebraska we have facts well ascertained by a competent observer; they are not open to the same kind of explanation; and they seem to afford the necessary confirmation of the supposed contemporaneity of man and the mastodon and elephant in this valley.

Dr. George Engelmann gave some results of his observations on the venation of American oaks. He has observed great differences in the venation of different species, some having folded or conduplicate, and others revolute foldings, and still others are concave and imbricated. But the venation does not seem to furnish characters distinguishing between the two principal sections, the white and black oaks.

June 5th. Dr. George Engelmann read a communication on certain fungi of the grape and oak.

Professor Riley exhibited specimens of the periodical Cicada, in the pupa and perfect states, recently received from Mr. Charles McCorkle, of Lexington, Va. Eight years ago Professor Riley had shown that there were thirteen as well as seventeen year races of this periodical Cicada, and in a chronological history of the species he had at that time predicted that "in the year 1876, and at intervals of seventeen years thereafter, they will in all probability appear from Raleigh, North Carolina, to near Petersburg, Virginia; in Rowan, Davie, Cabarras, and Iredell counties in North Carolina; in the valley of Virginia as far as the Blue Ridge on the east, the Potomac River on the north, the Tennessee and North Carolina lines on the south, and for several counties west; in the south part of St. Mary's County, Maryland, dividing the county about midway east and west; in Illinois about Alton; and in Sullivan and Knox counties, Indiana."

The specimens from Mr. McCorkle were proof of the correctness of the prediction in regard to Virginia. While this insect requires thirteen or seventeen years, according to the race, for its underground development, the actual development has never been watched from the egg to the mature insect. In 1868 he had collected together in a particular spot near this city a large number of the hatching eggs of a thirteen-year brood which will appear here again in 1881, and he had been able to obtain and note the development of the larvæ every year since. They are now about two thirds grown.

He also exhibited cocoons and spinning worms of the common mulberry silk-worm (*Sericaria mori*) reared on Osage orange. The worms were a cross between the best French and Japanese races, and he had reared them for five years on Osage orange with no reduction in quantity or quality of silk, and great increase of vigor and healthfulness. There is no reason why our ladies might not be dressed with silk from our own native hedges.

June 19th. Professor Riley exhibited specimens of a worm that was just at this time devastating the wheat fields of parts of Kansas, and particularly of Dickinson County. It does not eat the blades but attacks the heads. Professor Riley had determined the species to be *Leucania albilinea*, though the insect had never before been reported as injurious from the West. The species is generically allied to the common army worm, and may be popularly called the wheat-head caterpillar. As it had never till lately attracted unusual attention, too little was yet known of its habits to warrant any suggestion as to the best mode of destroying it.

Professor Riley also exhibited a specimen of *Doryphora decemlineata*, that was so completely covered with a mite parasite belonging to the *Gamasidæ*, and apparently the *Gamasus coleopteratorum* L., that the point of a needle could not be placed on any part of the beetle's body without touching one of the parasites. He estimated that there were over eight hundred of the mites, and they had killed their victim. Aside from the toad and other reptiles, the crow, rose-breasted grosbeak, and domestic fowls among birds, which prey on the potato pest, he had, in his reports, figured or described no less than twenty-three insect enemies that attack and kill it. Only one of these is a true parasite, and the mite exhibited made the second, or just two dozen insect enemies in all.

He mentioned the fact in this connection that the *Doryphora* had reached New Hampshire, and was doing great injury along the Atlantic coast.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE held its twenty-fifth meeting at Buffalo, commencing August 23d and closing August 30th. In point of numbers, the variety and quality of papers read, and the harmony of its sessions, it was quite equal to any of its predecessors; while the warm hospitality with which the association was greeted by the citizens of Buffalo added a social charm peculiarly its own. The success of the meeting was largely due to the untiring endeavors of the local committee, and especially of Mr. Grote and Captain Dorr, and it is to be hoped that the Society of Natural Sciences, the initiator of the movement which brought the association to Buffalo, and the leader in its entertainment, may reap the reward that is its due in the higher esteem in which it will be held at home — the esteem it already has among kindred associations in the country.

The president, Prof. Wm. B. Rogers, guided the deliberations of the general session with marked grace and dignity, and, in his responses to the hospitalities proffered the association, his welcome to the foreign guests, and his parting words, showed that the wonderful felicity of diction, not to say eloquence, for which he was noted has not been dimmed by his long illness. This being "Centennial year," no less than sixteen foreign scientists of greater or less distinction were present, a number far exceeding that of any former meeting of the association; most of them were chemists and physicists, but among those in whom the readers of the NATURALIST are more generally interested were Professor Huxley, of England, and Drs. Torell, Lindahl, and Nordström, of Sweden. Drs. Torell and Lindahl indeed read papers before the Natural History Section, the former on the sources of the ancient glaciers of North America, the latter on the structure of the tongue in *Picus viridis*. Professor Huxley also spoke in general session of his impressions of America, in response to his welcome by President Rogers, and in Section B briefly discussed one of Dr. Wilder's papers on the brains of the lower vertebrates. A few papers were also read in the physical section by others of the foreign guests. All this gave a certain interest to the meeting which is not likely to be surpassed in kind for many a year.

Two of the permanent committees offered extended reports: one on weights, measures, and coinage, the outcome of which was a series of resolutions passed unanimously, deprecating any revival of the double standard of value in this country; the other on zoölogical nomenclature, where the committee reported an irreconcilable difference of view on certain points and propounded a series of inquiries for discussion at a future meeting. This report was referred to Section B, which appointed a special committee to print and distribute the report, with a view of obtaining the written opinion of naturalists at large upon the questions involved.

The association took the initiative in proposing an international congress of geologists at Paris in 1878, "for the purpose of getting together comparative collections, maps, and sections, and for the settling of many obscure points relating to geological classification and nomenclature." The committee appointed to attend to the matter consists of Professors Rogers, Hall, Hitchcock, and Pumpelly, and Drs. Dawson, Newberry, and Hunt; and Drs. Torell and von Baumhauer and Professor Huxley were added to represent the purpose of the association in Europe.

Two hundred and five members and fellows entered their names upon the register, and one hundred and forty-two new members were elected; seventeen fellows were added, among them Dr. E. B. Andrews, Mr. L. S. Burbank, Dr. E. Coues, Dr. C. Rau, and Prof. Daniel Wilson, of the Natural History Section.

All of the addresses were able and were listened to with marked attention. Ex-President Hilgard spoke of the History and Progress of Geodetic Science; Vice-President Young of Section A treated of his own department of Solar Physics; Chairman Barker of the chemical subsection explained the modern scientific ideas concerning the atom and the molecule. Mr. Morgan disappointed those of the anthropological subsection who had looked to their chairman for an address, but he certainly made up for the omission by the number and value of papers on the Iroquois with which he afterwards favored them; indeed, the new subsection of anthropology was in general remarkably well sustained. Vice-President Morse of Section B gave a most valuable and extended critical review of what American students have done for the doctrine of evolution, the only fault to be found with which was that it needed a supplementary notice by another to show what the speaker himself had done. It would almost seem as if this address had given the key-note to the sessions of the section, for comparatively few papers were presented which did not at least show with how powerful an influence the doctrine of evolution had possessed the thoughts of the speaker; and, as remarked by Professor Morse on closing the sessions, so far were evolutionary views from eliciting a storm of dispute, as would have been the case ten years ago, that exception had been taken to scarcely a single point. Unquestionably the most remarkable paper presented before this section was that by Dr. W. K. Brooks, of Boston, on proposed modifications in Darwin's theory of pangenesis, but space will not here permit a fair abstract; simpler even than that proposed by Darwin, it explained many points which were not met by the latter. One hundred and seventy-four papers were presented to the standing committee, of which all but about a dozen were read in full or by title; and these were almost equally divided between the physical and natural history sections.

The association was invited to meet at Nashville, Atlanta, and St. Louis; the first place was chosen, and August 29, 1877, selected as the opening day; the following are the officers elect: President, Professor Simon Newcomb, of Washington; Vice-Presidents: Section A, Professor E. C. Pickering, of Boston; Section B, Professor O. C. Marsh, of New Haven; Permanent Secretary, F. W. Putnam, of Salem; General Secretary, A. R. Grote, of Buffalo; Secretary Section A, Dr. H. C. Bolton, of New York; Section B, Lieutenant W. H. Dall, of Washington; Treasurer, W. S. Vaux, of Philadelphia; Chairman Subsection of Chemistry, Professor N. T. Lupton, of Nashville; Subsection of Microscopy, Dr. R. H. Ward, of Troy; Subsection of Anthropology, Professor Daniel Wilson, of Toronto.

The following papers were read in the order here given, under their respective subsections.

GEOLOGY AND NATURAL HISTORY.

W. H. Dall, On the Mode of Extrusion of the Ova in the Limpets. Burt G. Wilder, Notes on the North American Ganoids: (*a*) the Supposed Transformation of the Tail of *Amia;* (*b*) the Serrated Appendages of the Hyoid Isthmus of *Amia.* Warren Upham, On the Origin of Kames or Eskers in New Hampshire. Joshua Lindahl, Some new Points regarding the Tongue of *Picus viridis.* T. Sterry Hunt, On the Geology of Eastern Pennsylvania. James Hall, Note upon the Geological Position of the Serpentine Limestone of Northern New York, and an Inquiry regarding the Relations of this Limestone to the Eozoön Limestone of Canada. L. Elsberg, On the Plastidule Hypothesis. T. Meehan, On Self-Fertilization and Cross-Fertilization in Flowers. A. R. Grote and W. H. Pitt, The Water Lime Group of Buffalo. T. Meehan, On Graft Hybrids. W. K. Brooks, On the Provisional Hypothesis of Pangenesis. Albert H. Tuttle, On a new Species of Argulus. Burt G. Wilder, Notes on the Brains of the Fish-Like Vertebrates: (*a*) Myxinoids; (*b*) Sharks and Skates; (*c*) Chimera; (*d*) Teleosts. F. A. Gooch, A Note upon the Pitchstones of Arran. Fred. W. Simonds, On *Sycotypus* (*Busycon*) *canaliculatus* Linn. J. S. Newberry, The Relations of the Rocks of Ohio to those of Pennsylvania and New York.

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E. W. Morley, Results of Measurements of Eleven of Möller's *Diatomaceen Probe-Platten.* E. W. Morley, Micrometric Measurements of Rulings on Glass by Mr. Rogers. E. W. Morley, Micrometric Measurements of Rulings on Glass by Mr. Rutherfurd. W. H. Bullock, Simple

Means of adapting the Binocular Microscope to Defects in the Eye. R. H. Ward, Remarks on some American Contributions to the Development of the Modern Microscope. P. H. Van der Weyde, On a new System of Finder for the Microscope. P. H. Van der Weyde, On a few Simplifications of the Polarizing and of the Spectroscopic Microscope. P. H. Van der Weyde, On some Modifications and Special Attachments to the Microscope for Chemical Research. George Beatty, Results obtained by Double Staining of Muscular Tissue of Amphiuma with Picric Acid and Carmine.

SCIENTIFIC SERIALS.[1]

THE GEOLOGICAL MAGAZINE.— August. Contributions to the Study of Volcanoes, by J. W. Judd. Pebble Ridges, by T. M. Reade. Remarks on Mr. Burns's Paper on the Mechanics of Glaciers, by James Croll.

MONTHLY MICROSCOPICAL JOURNAL. — August. Observations upon Spermatozoa of *Amphiuma tridactylum*, by C. Johnston. On the Ossification Process in Birds, and the New Formation of Red Blood-Corpuscles during the Ossification Process, by Dr. L. Schöney. On a Possible Explanation of the Method employed by Nobert in ruling his Test-Plates, by W. A. Rogers.

THE GEOGRAPHICAL MAGAZINE. — August. Sketches of Life in Greenland. The Basin of the Ob and Yenisei Rivers. The Seat of War. Dr. Beccari's Third Visit to New Guinea, by H. H. Griglioni. The Sea-Level, by H. P. Malet.

ANNALES DES SCIENCES NATURELLES. — June 30th. Mémoire sur les Mœurs et l'Accouchement de l'*Alytes obstetricans*, par A. De L'Isle. Mémoire sur l'Embryologie de quelques Éponges de la Manche, par Ch. Barrois.

ERRATA.

IN the article on Progress of Ornithology in the United States, etc., published in the September number, the following corrections should be made : —

Page 540, 13th line from top, dele "and has recently been republished."

Page 541, add to the last line of the first paragraph, "and fifty prepared especially for this edition."

Page 544, 17th line from top, for "Lawrence and Fowler" read "Lawrence, Gregg, and Fowler."

Page 544, 16th line from bottom, for "Hoy and Barry" read "Pratten, Hoy, and Barry."

Page 545, 15th line from bottom, for "*Tringaæ*" read "*Tringeæ*."

Page 545, 9th line from bottom, for "myology" read "osteology."

Page 546, 11th line from bottom, for "Rogers and Wilkes" read "Perry and Wilkes, and Lieutenant Gilliss."

Also, in the article entitled Microscopes at the Loan Collection of Scientific Apparatus at the South Kensington Museum, the author's name should be "John Michels," instead of "John Nichols."

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[1] The articles enumerated under this head will be for the most part selected.

THE

AMERICAN NATURALIST.

VOL. X. — NOVEMBER, 1876. — No. 11.

A REMARKABLE LIFE HISTORY AND ITS MEANING.[1]

BY W. K. BROOKS.

NAVIGATORS in tropical seas often speak of sailing for days through regions where the water of the ocean, to a depth of many feet, is filled with small transparent animals, which are attached to each other in such a way as to form chains or trains like trains of cars. Although these animals are perfectly transparent and jelly-like in appearance, the fact that their bodies are of sufficient consistency to admit of their being somewhat roughly handled, or even removed from the water, without essentially changing their shape, at once distinguishes them from such animals as jelly-fishes; and a very superficial examination is enough to show that they are quite different from these in organization. They belong to the group Tunicata, animals which have been classed with the Mollusca, although we now know that the resemblances which formerly led naturalists to this idea of their affinity are merely superficial, and without scientific value.

Most of the Tunicata are, in their adult state, attached to heavy bodies which rest upon the bottom of the ocean; stones and shells, for instance. A few, however, are locomotive and are to be met with swimming at the surface; most of the latter belong to the genus *Salpa*, and to these we will at present confine our attention. Although the Salpæ are most often met with in the warmer parts of the ocean, they are by no means confined to the tropics, but have been found south of the most southern point of Australia, and north of Scotland and Norway. They are abundant only after the water has been for some time undisturbed by winds, and as calms are more frequent within the

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[1] A paper read before the Kirtland Society of Natural History of Cleveland, Ohio. The cuts are from a paper upon the development of Salpa, in the Bulletin of the Museum of Comparative Zoölogy, and were kindly loaned for this article by Mr. Agassiz.

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tropics than in more northerly or southerly latitudes, the former seas are more favorable than the latter to the development of these animals, which multiply with astonishing rapidity when furnished with abundant food. As they feed upon the microscopic

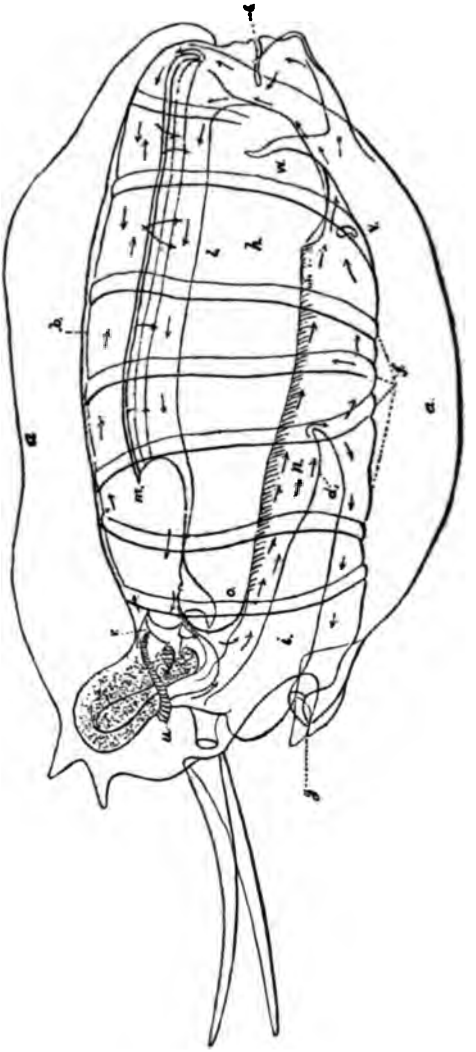


FIG. 43. Side view of an adult solitary Salpa, with the hæmal surface above: *a*, test; *b*, outer tunic; *d*, wall of atrial chamber; *e*, branchial aperture; *f*, muscular girdles; *g*, atrial aperture; *h*, breathing chamber; *i*, atrial chamber; *l*, epipharyngeal fold; *m*, endostyle; *n*, gill; *o*, mouth; *r*, heart; *u*, chain of males; *v*, ganglion; *w*, languette.

rhizopods which swarm at the surface of the ocean after a long-continued calm, they are then met with in numbers which defy description, and cannot be conceived by those who have not actually seen them.

Although single animals of our species are from one half to two thirds of an inch long, they are often so abundant that a bucket of water dipped at random from the surface of some sheltered bay will be found to contain many hundreds or even thousands. At such times collecting with the surface net becomes impracticable; for almost as soon as the net is placed in the water it becomes choked with a solid mass of Salpæ, so that nothing more can enter it, and unless Salpæ are what are wanted work must be abandoned until fresh winds again clear the water. A drop from an organic infusion swarming with Paramecia, seen under a low power of the microscope will give some conception of the appearance of the ocean when Salpæ are abundant, except that the water is not turbid like that of an infusion, but is perfectly fresh and clear; and no one who has not seen these animals under favorable conditions can form any conception of the amount of animal life which pure sea-water is able to support. The various species of Salpa vary in size, from those less than half an inch to those which are nearly a foot long, our species, as already stated, being about two thirds of an inch in length.

The animal (Figures 43 and 44) may be roughly described as a barrel or hollow cylinder, *b*, with a valvular opening at each end. The valves which guard the anterior opening (Figures 43, 45, and 55, *e*) are so arranged that while they allow the water to pass between them into the hollow chamber, *h*, they prevent it from passing out through the same opening; while those at the posterior opening (Figures 43, and 45, *g*) permit it to pass out but prevent its entrance. Around the barrel are a number of muscular belts like the hoops around a barrel (Figures 43, and 44, *f*), the contraction of which diminishes the capacity of the hollow chamber, *h*, and thus drives the water out through the posterior opening in a violent stream, which propels the animal forward. Upon the relaxation of these muscles a new supply of water passes in through the anterior opening, to be expelled in turn by the next contraction. As this pumping action is constantly going on, the animal is continually moving forward in a nearly straight line.

Wherever Salpa is found, two forms are met with, agreeing pretty closely in size and organization, but differing in outline and in some other slight details. (Compare Figures 43 and 45.) One of these forms, that shown in Figures 43 and 44, is called the "solitary Salpa," since each animal is entirely independent of all the others; while those of the other form (Figure 45) are called "chain-salpæ," since they are usually found united in a chain. Twenty-five or more of the barrel-shaped bodies are placed in a row, end to end, and each one is fastened to its neighbors before and behind it; this row is placed beside another similar to it, and each animal is fastened to two of its neighbors in the other row, so that the whole group of fifty or more forms a chain something like two trains of cars side by side on parallel tracks; only, to make the comparison more perfect, we must imagine each car chained to two cars in the other train, as well as coupled to those before and behind it. Since the animals are fastened in such a way that the posterior openings of all point in the same direction, all the streams of discharged water are driven in the same way and the whole chain moves forward with a uniform, steady motion. Figure 47 shows a few of the Salpæ from a chain, at a very early period of development, but as the animals are, unfortunately, not sufficiently far advanced at this time, the figure fails to give a very clear idea of the way in which they are united.

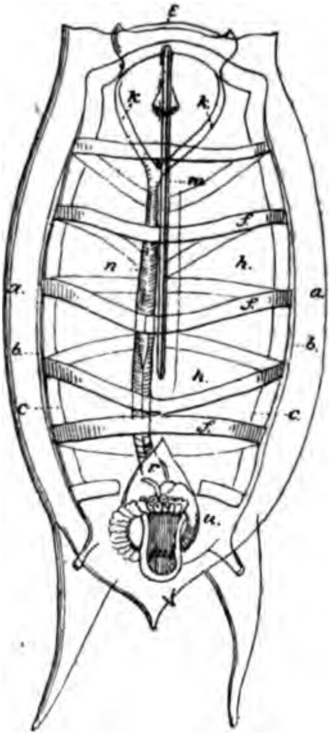


FIG. 44. Adult solitary Salpa, hæmal view : *a*, test ; *b*, outer tunic ; *c*, wall of breathing chamber ; *e*, branchial aperture ; *f*, muscular girdles ; *h*, breathing chamber ; *k*, peripharyngeal ridges ; *m*, endostyle ; *n*, gill ; *nu*, "nucleus" or digestive organs ; *r*, heart ; *u*, chain of males.

Salpa is very remarkable for the number of examples it presents of deviation from laws which are almost uniformly conformed to throughout the animal kingdom. One of the most striking of these anomalies is the periodical reversal of the action of the heart. This was discovered in 1824 by Van Hasselt, and although it is not peculiar to Salpa, but is shared by all the Tunicata, can be best studied in this genus, owing to its transparency. The body of the animal is so perfectly transparent that

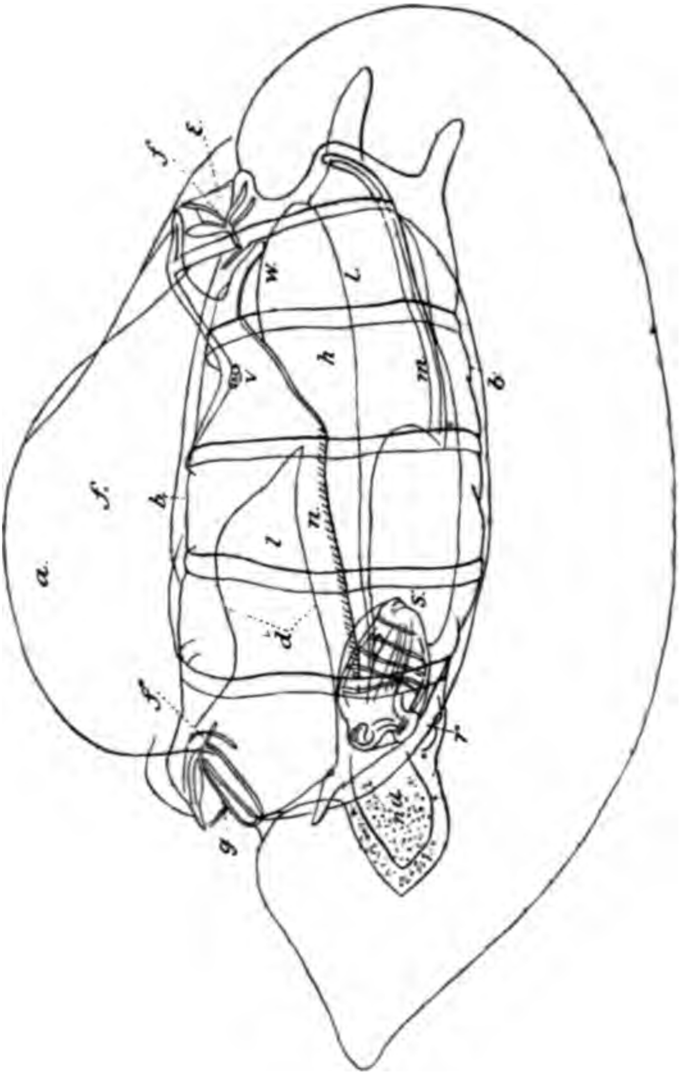


FIG. 45. Side view of adult chain-salpa, figured with the neural side uppermost: *a*, test; *b*, outer tunic; *d*, atrial tunic; *e*, branchial aperture; *f′*, muscles of branchial aperture; *f″*, muscles of atrial aperture; *g*, atrial aperture; *h*, breathing chamber; *l*, epipharyngeal fold; *m*, endostyle; *n*, gill; *r*, heart; *s*, embryo; *u*, ganglion; *w*, languette.

the pulsations of the heart may be seen without difficulty, and with a microscope the circulation of the blood may be traced to all parts of the body. After beating regularly for some time the heart suddenly stops, and for an instant the blood of the whole body comes to rest; this stoppage does not last for more than a second, and the pulsation and circulation then recommence as vigorously as before, but in the opposite direction, so that the blood-channels which before served as arteries and carried blood from the heart now perform the function of veins.

More careful examination will show what is possibly the reason of these changes. The blood does not circulate in true vessels with distinct walls, but in the spaces between the various organs of the body; thus it often happens that a space or sinus may have a large passage leading to it on one side and a very small one on the other, and the blood which enters the chamber through the large passage, being unable to escape with equal rapidity through the small one, soon accumulates and forms a dam or obstruction. As soon as the current is reversed, this obstruction is, of course, driven away from the small opening and gradually discharged again through the large one. Another peculiarity which Salpa shares with the other tunicates is the presence of an outer shell or test containing "cellulose." Cellulose is the substance which forms most of the tissues of plants; and although it is almost universally present in vegetables, it is found in only a very few animals, and is often stated to be one of the features which distinguish the vegetable from the animal kingdom. Salpa, however, together with a few other animals, is partially composed of true cellulose. In Figures 43, 44, and 45 the cellulose test, *a*, is shown as a thick transparent shell or outer tube, covering the remaining organs of the body.

By far the most interesting peculiarity of our animals is that the two forms, which are always found in the same locality, are of the same species. Nearly fifty years ago Chamisso ascertained that the solitary Salpa gives birth to a chain, and that each of the chain-salpæ in turn gives birth to a single solitary Salpa; and to this phenomenon he gave the name of "alternation of generations." At about the same time he published his famous story of Peter Schlemihl, who, for an inexhaustible purse, sold his shadow to the devil, and, through lack of this important appendage to his body, became involved in numerous entertaining misfortunes and vexations which his money was powerless to prevent. At this time nothing was known in regard to the wonderful changes which so many of the invertebrates undergo in passing from the egg to the perfect form; and the existence of animals whose children resemble their grandparents, while they are quite unlike their parents, was so opposed to all that was known that Chamisso's discovery at first met with nearly universal ridicule and discredit. In fact, one of the greatest of naturalists is stated to have said that he could much more easily credit Chamisso's romance of Peter Schlemihl than his observations upon Salpa.

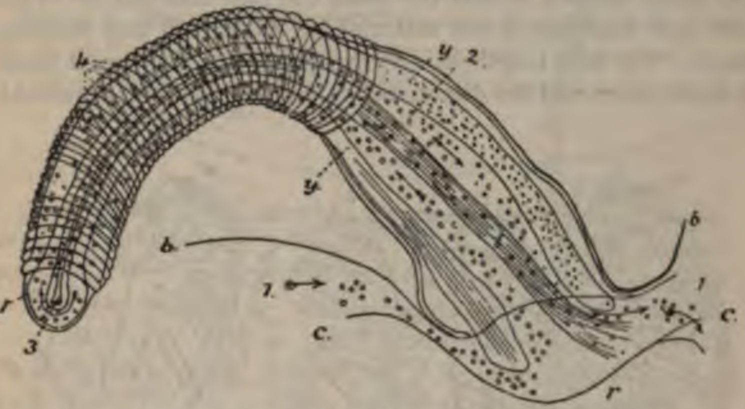


Fig. 46. Very young bud-tube, from a solitary Salpa: *b*, outer tunic; *c*, wall of pericardium; *r*, heart; 1, blood-channel; 2, cavity of tube; 4, constrictions upon the tube; *yy*, ovaries.

At this time our acquaintance with the lower invertebrates was increasing with wonderful rapidity, and it was soon found that several animals, especially the intestinal worms, go through an alternation substantially like that described by Chamisso as taking place in Salpa; the second generation being very different in external form, and, in many cases, in structure also, from the first. Within a few years from the time of publication of Chamisso's account Steenstrup's work upon Alternation of Generations appeared, and so much additional information was given by this that this method of development was shown to be not even anomalous or exceptional, but common to whole groups of animals. Salpa also was soon made an object of especial study by several eminent naturalists, and Chamisso's account was confirmed in all essential particulars; and the able memoirs of Sars, Krohn, Huxley, Vogt, and Leuckart have given us a nearly complete account of its life history. All these naturalists agree in holding the opinion that Salpa presents a real alternation of generations, as stated by Chamisso, and the history of its development, as given in their papers, is as follows: —

Each egg hatches into a single embryo of the solitary form (Figures 43 and 44). After this solitary Salpa has acquired most of the adult characteristics, but while it is still very small, part of the wall of its body becomes prolonged into a hollow tube, which is shown, very much magnified, in Figure 46. The cavity of this tube is in free communication with one of the blood-channels (1) of the mother, so that the blood can pass into and out of the tube and thus supply the material for its growth and development. The tube lengthens very rapidly, and as it grows it bends so as to pass round the digestive organs of the mother (Figure 44, *nu*) in a spiral (*u*) which lies between these organs and the outer wall of cellulose. Meanwhile a series of constrictions makes its appearance upon the surface of the tube (Figure 46), and in a short time the spaces marked off by these constrictions assume the shape and acquire the organs of young chain-salpæ, as shown in Figure 44, *u*. The chain-salpæ then are produced by a process of budding from the body of the solitary Salpa.

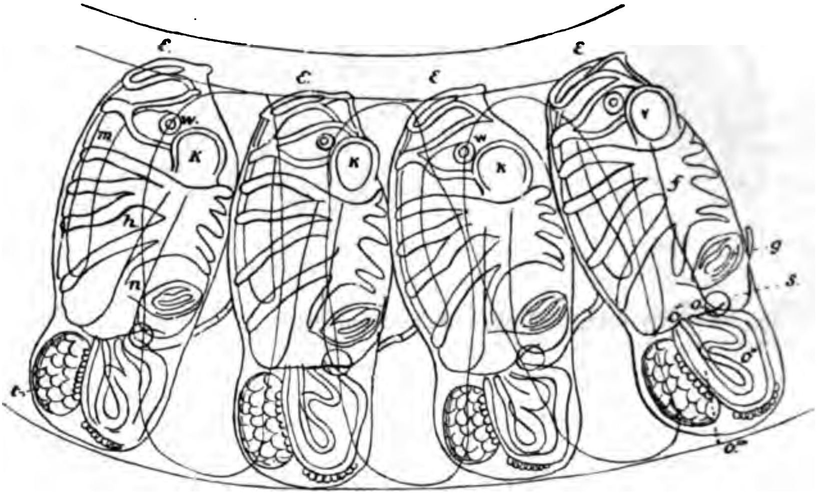
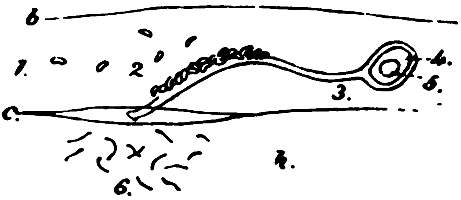
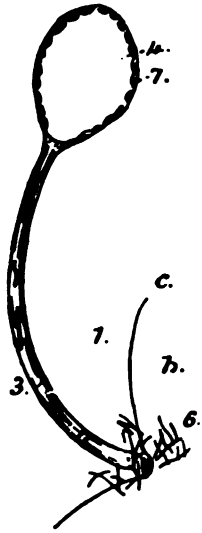


FIG. 47. Seven animals from a fully developed chain immediately before its discharge from the body of the solitary Salpa: *s*, egg; *t*, testicle.

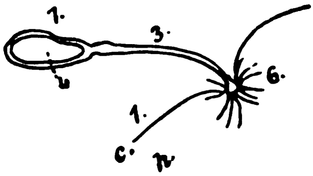
There are many hundred chain-salpæ thus marked off at one time upon the surface of the tube, but the forty or fifty nearest its free end develop much more rapidly than the rest, though uniformly as compared with each other. After their organs are perfectly formed, but while they are still very small, they become detached from the tube and escape into the water as a chain, the animals of which are now able to provide for themselves and grow very rapidly. Meanwhile another set is developed upon the tube of the solitary form, to be cast off in turn, so that the



(Fig. 48.)



(Fig. 49.)

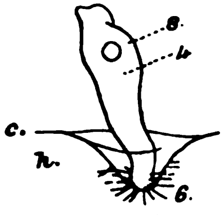


(Fig. 50.)

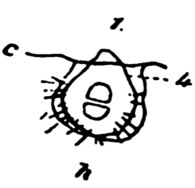
Fig. 48. Egg before impregnation.

Fig. 49. Egg during impregnation.

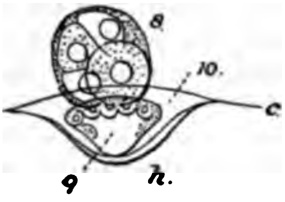
Fig. 50. The changes following impregnation : *b*, outer tunic of nurse; *c*, wall of breathing chamber of nurse; *h*, breathing cavity of nurse; 1,blood-channel of nurse; 2, blood corpuscles; 3, egg-stem; 4, yolk; 5, germinative vesicle; 6, spermatozoa; 7, capsule of egg; 8, nucleus.



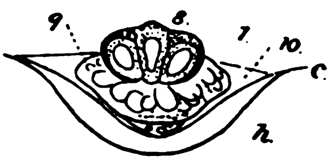
(Fig. 51.)



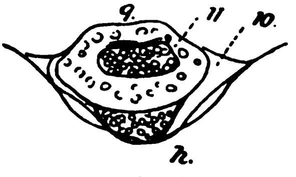
(Fig. 52.)



(Fig. 53.)



(Fig. 54.)



(Fig. 55.)

Figs. 51–55. Successive stages of segmentation: *c*, wall of breathing chamber of nurse; cavity of same; 1, blood channel; 4, yolk; 8, food yolk; 9, germ yolk; 10, orifice of blood sac; 11, invagination orifice; *h*, breathing cavity of nurse.

latter continues to set free chains from time to time, as they become matured.

The solitary Salpas themselves are produced in quite a different way. At the time the chain is set free each of its component animals contains a single egg (Figure 47, *s*) as well as a testicle (*t*), which is at this time immature and is composed of a mass of undifferentiated cells, as shown in the figure.

The eggs, on the contrary, are fully developed and ready for impregnation, which soon takes place, and is accomplished in a very remarkable manner. The egg (Figure 48) lies in one of the blood-channels (1) of the chain-salpa, which we shall hereafter call the "nurse." It is bathed freely by the blood, but is not itself free within the channel, being mounted upon a long stalk (3), like a cherry upon its stem, and the end of this stem is attached to the large chamber (Figure 45, *h*), which we have already described as filled with sea-water, and which we shall hereafter designate as the breathing chamber.

In Figure 48, *c* represents the wall of this breathing chamber, and *h* its cavity, which is open externally and is filled with water at each contraction of the muscular bands. As Salpa when found at all is very abundant, the water always contains plenty of full-grown chains, as well as the young and immature egg-bearing ones. The testicle in the full-grown chain-salpa is fully formed, and this discharges its spermatic fluid into the water, which accordingly contains great numbers of fresh and actively moving spermatozoa. Some of these are drawn, with the respired water, into the breathing chambers of the young nurses, and these may be seen to congregate at the point where the egg-stem is attached, as shown in Figures 48, 49, and 50. Some of these may be seen to penetrate the stem, and work their way up towards the egg, which is thus fertilized. After impregnation the stem shortens and swells as shown in Figures 49, 50, and 51, and draws the egg down into a "brood-chamber," or pouch, which is formed in the wall of the breathing chamber. The opening of this pouch still connects it with the blood-channel, of which its cavity is a diverticulum, so that the egg is still bathed and nourished on all sides by the blood, and increases in size very rapidly during segmentation, some of the stages of which process are shown in Figures 51, 52, 53, and 54. After the formation of the gastrula the blood not only bathes the outside of the embryo but also passes into and out of the gastrula mouth (Figure 55, 11).

A constriction now makes its appearance and divides the embryo into two portions, of which the one nearest the blood channel of the nurse becomes developed into a true placenta (Figure 56, 12), similar, in function as well as in structure, to that of a fœtal mammal, while that portion which is directed towards the breathing chamber becomes developed into the embryo proper. This is nourished with the blood of the nurse by means of the placenta, and grows very rapidly and soon assumes the characteristics of the solitary form. In Figure 57 an embryo is figured as it appears when development is very much advanced. It is

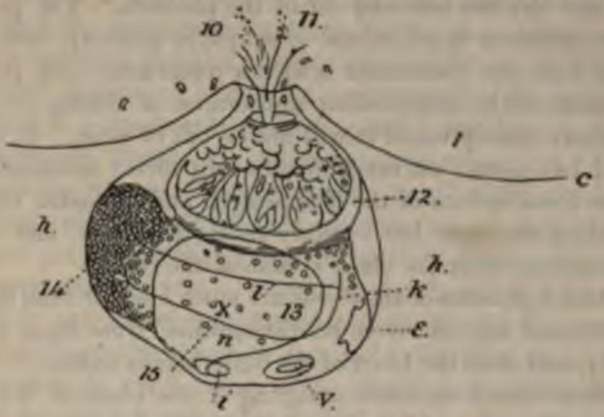


FIG. 56. Embryo of solitary Salpa.

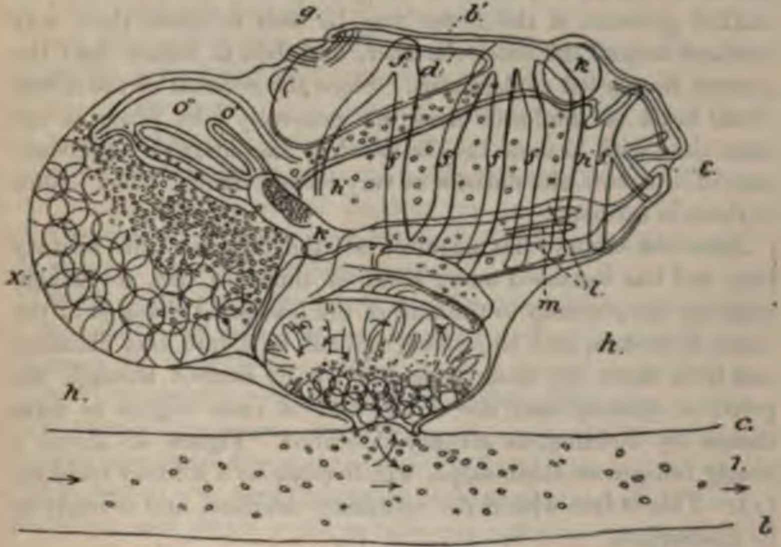


FIG. 57. Embryo more advanced, and ready to be discharged.

seen to be attached by a narrow neck to the wall (*c*) of the breathing chamber (*h*) of the nurse. In this figure, 1 represents the blood-channel of the chain-salpa, and the arrows show the direction of the currents into and out of the placenta. The presence of a true placenta in an animal so simple in structure and so far removed from the mammalia is such a remarkable and interesting instance of the independent appearance of similar structures that a short description of it will not be out of place. It is composed of two parts: an inner chamber in direct communication with the blood system of the chain-salpa, and an outer chamber surrounding the inner but entirely shut off from it, and in free communication with the blood system of the fœtus.

The blood globules of the fœtus are much smaller than those of the nurse, and may therefore be distinguished from them without difficulty, and after the heart of the fœtus begins to beat, it is easy to see that there is no direct mingling of the blood of the nurse with that of the fœtus, but simply a very close contact, exactly as is the case in the mammals. The large globules of the nurse can be seen to enter the inner chamber of the placenta, course around it through the intricate channels into which it is divided, and then leave it to return to the general circulation; while the smaller globules of the fœtus may be seen to make their way into and around the outer chamber, and then to return into the general circulation of the fœtus. Since the reversal of the action of the heart of the fœtus does not generally take place at the same time with that of the chain-salpa, the complete independence of the two circulations is very clearly shown when either of them is reversed.

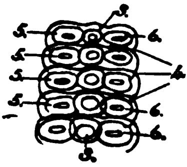
After the embryo has acquired all the organs of the solitary form and has increased many hundred times in size, its attachment by the placenta to the wall of the breathing chamber of the nurse is broken, and the young animal falls into this chamber and lives there for some time, but finally escapes through the posterior opening into the water, and at once begins to form chains by budding, as already described. Figure 45 shows a nearly full-grown chain-salpa, which contains a solitary embryo, (*s*). This is free within the breathing chamber, and is ready to be discharged.

Figures 44 and 45 are drawn to nearly the same scale, Figure 45 being only a little more magnified than Figure 44. Figure 44 represents a solitary Salpa, which contains a chain, *u*, which is ready to be discharged into the water, while Figure 45 represents a chain-salpa, containing an embryo of the solitary form, *s*, which is also ready to be discharged. It will at once be seen, by a comparison of these figures, that although the two forms differ little in size when full grown, the solitary form is many hundred times larger than the chain-salpa at birth. After the embryo escapes from the body of the chain-salpa, the testicle of the latter becomes fully developed, and its spermatic fluid is discharged into the water to gain access to the breathing chambers of younger chain-salpæ and fertilize the eggs carried by these.

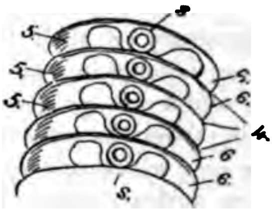
Such is the history of the two forms, as it has been traced by the distinguished naturalists already mentioned, each of whom has added portions of the process which had escaped the notice of the previous observers. Many other embryologists have contributed to our knowledge of the subject, but those mentioned have made Salpa the object of long and exhaustive research, and the summary of their observations may be stated as follows: The egg hatches into an embryo which becomes a solitary Salpa. Each solitary Salpa gives birth to chain-salpæ by a process of budding from the walls of a tube. Each chain-salpa contains a single egg, which undergoes internal impregnation, and forms a solitary embryo, which is nourished by a true placenta. The adult chain-salpa is furnished with a testicle.

From these statements, which are perfectly accurate, the conclusion has been drawn that Salpa presents an instance of alternation of generations. It is almost unnecessary to say here that this term is applied to the reproductive process of those animals among which the egg gives rise to a sexless animal which in time gives origin, by a process of budding, to sexual forms, which in turn reproduce the sexless form by eggs. The hydroids furnish well-known illustrations of this process.

Since in Salpa the eggs as well as the male fluid are found in the animals of the chains, while these are produced asexually as buds from the body of the solitary Salpa, it seems reasonable to conclude that the reproductive process in Salpa is similar to that of the hydroids, the solitary form being the sexless and the chain-salpa the hermaphrodite sexual form; and this view is now generally accepted. I have said that the account which I have given above, and which seems to fully support this conclusion, is strictly accurate; but it is not quite complete. A few of the early stages of development have escaped the notice of all observers, and these few stages put the whole matter in an entirely new light, for they show that the solitary Salpa is the female, and the parent not of the males alone but of the eggs which they carry as well, and therefore of the embryos which these eggs produce. Although the chain-salpa gives birth to the solitary form, it is not its mother, but simply a nurse. It is not even the father of the egg which is fertilized within its body; although, after it has discharged its own embryo it may become the father of the embryos carried by other chain-salpæ. In order to explain this utterly anomalous and apparently contradictory manner of development, it will be necessary to trace a little more minutely the early stages in the formation of the animals which compose the chain. It will be well to call attention, in the first place, to the fact that no female animal or plant we know of has the power to form only a single egg or seed, and it is plain that if there were such an organism, it would gradually become extinct, since each generation could be as numerous as the one before it only when every embryo survived all accidents and reached maturity.



(Fig. 58.)



(Fig. 59.)

Fig. 58. Five Salpæ from a tube, at a very early stage of development.

Fig. 59. The same, still earlier: 4, the constrictions which mark out the animals; 5, ganglia; 6, digestive organs; *s*, ovum.

The fact that the chain-salpa contains only one egg is in itself enough to excite a suspicion that it is not the true female; but in answer to this argument it might be said, fairly enough, that the whole history of Salpa is a series of anomalies, and that, since one more or less would not make much difference, there is no great difficulty in believing that it differs from all other animals in producing only one egg. It might be urged that indefinite multiplication is provided for by the power of the solitary form to produce large numbers of chains. As we trace back the development of the chain-salpa we soon find much stronger reasons for doubting that this is the parent of the egg which it contains. The sexual products are not usually matured until the animal has reached its adult form, and very few animals reproduce during their embryonic or larval stages; but almost immediately after the chain-salpa is born, and when it is less than a fiftieth of its adult size, its egg is fertilized. Going back to a still earlier period we find that when the organs of the chain-salpa first begin to make their appearance upon the walls of the tube, each one contains a full-grown egg, as shown at *s* in Figure 58. At a still earlier period, when the only indication of the future chain-salpa is the constriction upon the surface of the tube, each space thus marked off contains a single, full-grown egg, which appears to be as fully ripe as at the time of impregnation. Figure 59 shows five of these constrictions at this time, and their eggs (*s*).

At a still earlier stage, before the constrictions appear upon the wall of the tube, this is seen to contain two large club-shaped bodies (Figure 47, *yy*), which under careful examination with high powers are found to contain germinative vesicles; and by patient examination of large numbers of solitary Salpæ at about this period, a few may be found which show that these bodies are made up of rows of eggs and are therefore ovaries, and the solitary Salpa must be regarded as the female, since the chain-salpa cannot be the parent of an egg which exists before the chain-salpa itself is formed.

We must therefore conclude that, instead of an instance of "alternation of generations," we here have simply a remarkable difference in the form and mode of origin of the two sexes, for we must regard the solitary Salpa as the female and the chain-salpa as the male. The life-history of Salpa may then be briefly stated in outline as follows: The solitary Salpa is the female, and produces a chain of males by budding, and discharges a single egg into the body of each of these before birth. These eggs are impregnated while the chain-salpæ are very small and sexually immature, and develop into females which give rise to males by budding. After the fœtus has been discharged from the body of the male the latter attains its full size, becomes sexually mature, and discharges its spermatic fluid into the water to gain access to the eggs carried by other immature chains.

It is worthy of notice that although Chamisso's announcement of the occurrence of alternation of generations among animals is thus seen to have been drawn from the study of animals which do not present an instance of it, this mistake has been of the greatest usefulness, since it has led to our knowledge of the numerous instances of true alternation which now form such a large and important chapter of zoölogical science. The relation in which Salpa stands to the other tunicates shows also that no abrupt line can be drawn between alternation and ordinary sexual reproduction, but that they are different forms of the same process. In a future paper I hope to say a few words upon this subject, and to show how all the strange peculiarities of Salpa receive a simple explanation upon the theory that it is the descendant of an ordinary tunicate which has been modified by natural selection.

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PLAIN, PRAIRIE, AND FOREST.

BY PROF. J. D. WHITNEY.

PART II.

THE more the prairies are studied, the less will one feel disposed to adopt any theory for their origin dependent on climate, and the more will the attention be turned to the question of the character of the soil, the distribution of the geological formations from which this soil has been derived, and the cycle of recent geological events by which it has been distributed and accumulated in its present position. It is evident, however, that in the discussion of a question of this kind full details of the observations made cannot be given; they would occupy volumes. It is for the observer himself, on carefully analyzing and classifying the results of his examinations, to state the conclusions at which he has arrived; a catalogue of the localities visited would be of little service to any one else in enabling him to form an independent opinion.

As the result of a great number of observations made over all the prairie States, we find, almost without exception, that absence of forests is connected with extreme fineness of soil, and that this fine material usually occurs in heavy deposits. It seems hardly necessary to enlarge on the characteristics of the so-called "prairie soil." To look at a plow with which the prairie has been broken up ought to be a sufficient indication of this fineness. How often has the writer admired the beautiful polish put upon this common utensil used on the western prairies, and contrasted its appearance with that of the scratched and battered article with which the hills of New England had been belabored. Let us, however, quote a few paragraphs illustrative of the nature of the prairie soil from some of the Geological Survey Reports, beginning with that of Illinois.

"All the part of the county [Boone, Illinois] south of the Kishwaukee may be called a treeless prairie, characterized by long, low, undulating rolls and low ranges of hills and ridges. In some places it is flat, with swales and sloughs of limited extent, between moist marshes and black, fat meadow lands. A few trees skirt along Coon Creek, and scattered patches of timber in one or two other places relieve the level landscape. A broad, rich, comparatively level Illinois prairie, these hundred noble sections preserve yet some of that primitive beauty which gave two townships [Spring and Flora] their names. Before the busy teeming millions of the sons of toil swarmed over the fertile West, prairie flowers, in spring-like beauty and autumnal glory, bloomed where now the glancing plow-share turns the spring furrow, and the golden-ripened wheat-fields dally with the fugitive winds. The purple and golden clouds of flowers that used to lay on these prairies are now no more; but in their place the tasseled Indian corn waves its head, and men are growing rich from the cultivation in useful crops of these old flower-beds of nature." [1]

Again, from the Missouri Reports: "Timber is not very abundant in Saline County. . . . . Throughout almost its entire area, there is a deep, rich, black soil, of unsurpassed fertility. The ease with which these beautiful, rich, mellow prairie lands can be cultivated almost makes the toil of the husbandman a pleasure, while their freedom from rocks, roots, stumps, and other impediments enables him to use the various modern labor-saving agricultural implements with astonishing effect." [2] Next, from the Iowa Report: "The scarcity of timber has, doubtless, had much to do in retarding the settlement of this fine region [Ida County]. . . . . The soil throughout the county is mainly of bluff origin. It consists of a buff-colored, *exceedingly finely comminuted* silicious earth. The bluff formation overspreads the entire county, enveloping the uplands in a deep mantle of the peculiar silicious deposit of which it is composed. In the southern portion of the county it probably attains its greatest thickness, where it cannot be less than one hundred feet." [3] It seems hardly necessary to multiply quotations of this kind, as might be done to any extent. No person can have traveled through Southern Wisconsin, Illinois, Iowa, or Missouri, without having had everywhere occasion to notice the prairie soil and to find out what its characters are, and that, as a general rule, it is exceedingly fine and deep. There are whole counties in Iowa where not a single pebble can be found; children are born and grow up without ever having seen a fragment of stone, a bowlder, or even a pebble large enough to throw at a dog.

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[1] Worthen's Illinois Report, v. 95.

[2] Reports of the Geological Survey of Missouri, 1855–1871, pp. 159 and 179.

[3] C. A. White in Geology of Iowa, ii. 163.

If, then, this extreme fineness of the soil is the cause of the absence of forest growth, we ought to be able to explain, when looking at the facts from this point of view, that which from any other theoretical stand-point has seemed entirely inexplicable. The apparently eccentric distribution of the timbered tracts within the prairie, and of forest-covered patches in the midst of great treeless regions, — these conditions, which are evidently so little connected with absence or presence of moisture, and which seem so obscure, how clear they become when we examine the soil itself, instead of interrogating the skies and the rain-tables!

How, then, are the wooded tracts distributed in the prairie region? An examination of the maps before us, on which the prairies of Illinois, Wisconsin, Iowa, and Minnesota are designated, from materials collected at the General Land Office, shows clearly that, as a general rule, it is the higher portion of the country which is destitute of timber. All are probably somewhat familiar with the terms commonly in use at the West, "river-bottom," "bluff," and "prairie upland."[1] All are aware that the prairie country has, in general, a moderately undulating surface, and that the streams, which are very numerous, have sunk their beds to a depth of from a few feet up to two hundred or three hundred below the general level; that these valleys are often very wide in comparison with the size of the streams which meander through them, and that the ascent on to the uplands is not a gradual one, but usually rather steep, such steep ascents being universally known as "bluffs." These bluffs often, especially in Wisconsin, Northern Iowa, and Northern Illinois, exhibit outcropping edges of rocks, forming low, nearly perpendicular ledges, the geological formations lying almost everywhere in the prairie region in a nearly horizontal position, and consisting of nearly, if not quite, unaltered limestones, shales, and argillaceous sandstones.

As a general rule, the timbered tracts are found in one of two positions: either they stretch along the bluffs which border the river valleys, or they occupy patches, called groves, high up on the uplands, at a level of a few feet — rarely as much as a hundred — above the surrounding prairies. The river bottoms themselves are sometimes quite heavily timbered, but frequently treeless and covered with grass, and then known as "bottom prairies." In Illinois, of which State perhaps three quarters to two thirds are prairie, the wooded tracts are almost entirely in the river valleys or along the edges of the bluffs; the uplands, or rolling and nearly flat plains between the streams, are, to a large extent, destitute of timber. Very much the same condition of things exists in Iowa. Here, however, a considerable portion of the surface east of a line drawn in a northwesterly direction from the mouth of the Makoqueta River to the state line is pretty well timbered, while west of this there is a gradually increasing deficiency as we go towards the Missouri. All through the State, however, except in the northwest corner, there are isolated patches of timber on the upland, often forming beautiful and extensive areas of woodland. In Wisconsin the prairie region lies mostly to the north of the river of that name. Just along the river is a narrow belt of prairie, in interrupted patches. Then, twelve or fifteen miles farther south, comes an extensive and continuous prairie, stretching along from east to west and occupying the divide between the waters flowing into the Wisconsin and those tributary to Rock River. It was on this line of prairie that the famous "military road" was built by the government to connect Lake Michigan with the Mississippi, and which was once of so much importance. South from this east and west line of prairie run several broad patches of the same, gradually widening southwards, and occupying more than half the surface when we reach the Illinois state line. In the midst of these areas of prairie are fine groves of timber, quite dense, sometimes near a creek and sometimes far away from water. In the bend between the Wisconsin and the Mississippi, as the latter curves to the east just before passing Cassville, there is a beautiful, isolated prairie, about fourteen miles long and twelve wide in its widest part, having one large grove near its southeastern edge. Space is wanting to enable us to indicate all the peculiarities of the distribution and intermingling of prairie and timber from Minnesota to Arkansas; but the reader must surely have bcome convinced that inequality in the distribution of moisture offers no solution of the problem before us.

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[1] For a careful description of the surface in the prairie region, by the present writer, see Hall and Whitney's Geology of Iowa, 1858, vol. i., chapter 1.

Let us turn, at present, to the geological side of the investigation. The whole of New England and New York, and a large part of Ohio and Indiana, together with the whole of Michigan and of Northern Wisconsin, constitute a region over which the northern drift phenomena have been displayed on a grand scale. Consequently, almost the whole of this area is covered with heavy deposits of coarse gravel and bowldery materials. These deposits, if not at the surface, are near it, and the finer materials deposited on them, by alluvial and other agencies, generally form only a thin covering for the coarse deposits beneath. But as we go south and west from the region indicated above, we find the underlying rock — the "bed-rock," as the Californian miners would call it — deeply covered with loose materials, it is true, but we observe also that these are quite different in character from what they are to the north and east. We come to a region where the drift agencies have been very limited in their action. The bulk of the superficial detritus has been formed from the decomposition of the underlying rock, and this detritus has been but little disturbed or moved from its original position. If erratic deposits exist, they are usually deeply covered with finer materials derived from close at hand. A great area exists in Wisconsin and Minnesota over which not a single drift pebble has ever been found, either at the surface or at any depth beneath it. The strata have become chemically disaggregated and dissolved by the percolation of the rain through them, the calcareous matter has been carried off in solution, and there is left behind as a residuum the insoluble matter which the rock originally contained, and which, consisting largely of silica and silicate of alumina, forms by its aggregation a silicious and clayey deposit of almost impalpable fineness. It is this fine material which makes up the bulk of the prairie soil; and, as the writer conceives, it is this fineness which is especially inimical to the growth of trees. Exactly as we see the desiccated lakes in the midst of the forests gradually filling up with finely-comminuted materials and becoming covered with a growth of grasses or sedges, which is not afterwards encroached on by trees, no matter whether the ground becomes completely dry or whether it remains more or less swampy, so we have the prairies, which have certainly never at any time been overspread with forests, and which would always remain as they are, provided the climate underwent no radical change and they were not interfered with by man. It is for the vegetable physiologist to say why this fineness of the soil is unfavorable to the growth of trees; it is for the geologist and physical geographer to set forth the facts which they may observe within the line of their own professional work.

From the point of view here established it is easy to explain phenomena which, if any other theory be adopted, seem to be entirely inexplicable.

The first question which occurs is this: Why are the prairies, or grassy plains in general, almost exclusively limited to areas which are comparatively level? No theories of climatic influence or unequal distribution of moisture seem to have any bearing on the solution of this question. But if we consider that in order to carry off the finest particles produced by the disaggregation of the rocks there must be currents of water having considerable velocity, we see that it is only in hilly regions that the soil will be washed out enough by the rapid flow of the streams to give rise to a soil sufficiently coarse to favor the growth of forests. Thus it happens that in the prairie region the growth of trees is so frequently limited to the bluffs which border the streams; it is because the inclination is sufficiently rapid to cause the water, as it finds its way down to the bottom of the valley, to take with it the finer particles which on the uplands remain undisturbed. When heavy rains fall, the water stands upon the surface in sheets and pools, and gradually soaks into the ground. For this reason the divides between the streams, where there is hardly any perceptible inclination of the surface, are occupied in preference by prairie lands. If the height of the bluffs be considerable and the eroding power of the stream sufficient to cut the country up into a succession of ravines with but little level ground between them, then the whole region will be more or less covered with timber, as is the case in Northeastern Iowa, although the conditions with regard to moisture are less favorable than in some other parts of the State. The groves of timber which stand isolated upon the prairie, in so many places, are found on examination to have grown upon coarser soil than that which surrounds them; in some cases, the deposits of coarse drift have escaped being covered by the prairie soil because a little more elevated in these spots, or the increased height has favored the washing away of the finer particles. The railroads which run through Northern Illinois, where prairie soil and drift soil are constantly alternating with each other, furnish excellent sections from which one can see at a glance, as he crosses the country, how dependent the growth of the forests is on the character of the soil. One, even if blindfolded, could tell without difficulty, in the great majority of cases, by feeling the soil, whether he was in a timbered or a grassy region. Thus we see Mr. Winchell, in his description of the "Big Woods" of Minnesota, admitting that the soil is coarser and more gravelly than it is on the adjacent prairies, although he sees no connection between this peculiar character of the soil and the exceptional existence of an extensive forest upon it, while at the same time recognizing the dilemma in which he is placed by his adoption of the prairie-fire theory. The writer has often noticed, during his explorations just on the western edge of the Lead Region, that the vicinity of old, abandoned shafts was becoming overgrown with trees, the fact being that in the sinking coarser materials underlying the prairie soil had been reached and thrown out in abundance on the surface, and that it was on this gravelly detritus that the trees were growing, the adjacent, undisturbed prairie remaining in its natural, grassed condition.

The distribution of the timbered and prairie tracts in Wisconsin, as already suggested, illustrates beautifully the dependence of the forest growth on geological conditions rather than on those having to do with climate. In the northern part of the State, as we see indicated on Professor Brewer's map, is a region of dense forest, although, as the table of rain-fall statistics given on a preceding page[1] shows, this is not a region of large precipitation. It is, however, heavily covered with coarse detrital materials, plentifully distributed from the "head-quarters of the drift," on Lake Superior. The rocks underlying the drift deposits are crystalline, belonging to the Azoic series, and the surface is rough and broken, being intersected with low ridges, and knobs of granite and trap. South of this is a large area occupying the central portion of the State and extending down as far as the Wisconsin River, almost exclusively occupied by a very pure silicious sandstone, which is wrapped about the Azoic region, extending in a northeasterly direction to the Menomonee River, and northwest to the Falls of the St. Croix. This great sandstone-covered area is the pine district of the State, while south of the Wisconsin is the region of oak openings and prairies. And when we reach these treeless tracts, the range and extent of which have already been indicated, we find that we have got entirely beyond the drift-covered area, and that we are upon a soil made up of the insoluble residuum left from the disintegration of several hundreds of feet in thickness of limestone and dolomites, which have been dissolved out and carried away by the rain, there being abundant evidence that this region has never been covered by water since it was first raised above the Silurian ocean. Thus we find the distribution of forest and prairie in Wisconsin to be most intimately connected with the nature of the soil and the geological conditions under which this has been formed, while it has been clearly shown that climatic conditions were either absolutely null in their action or else entirely secondary to those other more potent ones which have been designated.

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[1] See NATURALIST, x. 586.

Were there space enough, it would be possible to show, with abundant detail of description, how, all over the prairie region, the characters of the soil and the surface harmoniously combine to favor or repress the growth of forests, regardless of the amount or distribution of the atmospheric precipitation. A thorough working out of the surface geology of Missouri or Arkansas would especially well illustrate the correctness of the statements which have been here advanced, and the inferences which have been drawn from them.[1]

It remains to say a few words in regard to the views of Mr. Lesquereux. He, if we have correctly apprehended his theory, ascribes the existence of the prairies almost exclusively to the character of the soil. But he conceives this unfittedness for tree-growth to be, in some way not clearly apprehended by the writer, due to the "agency and growth of a peculiar vegetation." If we are not mistaken, the essential points of the theory of Mr. Lesquereux are — and, as far as possible, we will use his own words in setting it forth — "that all the prairies of the Mississippi Valley have been formed by the slow recess of sheets of water of various extent, first transformed into swamps and by and by drained and dried;" the soil thus formed "is neither peat nor humus, but a black, soft mold, impregnated with a large proportion of ulmic acid, produced by the slow decomposition, mostly under water, of aquatic plants, and thus partaking as much of the nature of the peat as of that of the true humus;" these plants "contain in their tissue a great proportion of lime, alumina, silica, and even of oxide of iron, the elements of clay. Moreover, this vegetation of the low, stagnated waters feeds a prodigious quantity of small mollusks and infusoria, whose shells and detritus greatly add to the deposits. The final result of the decomposition of the whole matter is that fine clay of the subsoil of the prairies, *which is indeed truly impalpable*, when dried and pulverized and unmixed with sand."

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[1] Mr. Gabb has shown (see American Journal of Science (3), ii. 127) that in Santo Domingo "the grass and tree regions are sharply defined, and correspond in the main with certain geological features."

The writer has taken the liberty of italicizing a few words in the last sentence quoted from Mr. Lesquereux,[1] in order that the reader may not fail to notice that there is an essential agreement between us on the main point, which is that of the fineness of the prairie soil. That is to say, the main point in the opinion of the writer, but apparently not in that of Mr. Lesquereux, for he says, in speaking of the absence of trees as being caused by the fineness of the soil, "This explanation, I think, cannot satisfy the mind." When, however, we seek in his chapter on the prairies for the essential thing which does bring the desired mental satisfaction, we do not find it clearly stated, unless it be in the following sentences: "It is easy to see why trees cannot grow on such kind of soil [namely, the prairie soil, as described above]. The germination of seeds of arborescent plants needs the free access of oxygen for its development; and the trees, especially in their youth, absorb by the roots a great amount of air, and demand a solid point of attachment to fix themselves. Moreover, the acid of this kind of soil, by its particularly antiseptic property, promotes the vegetation of a peculiar group of plants, mostly herbaceous." That is to say, the soil formed by the decomposition of aquatic plants is unfavorable to the growth of forests, not only on account of its fineness, which must certainly at least assist in preventing "the free access of oxygen," but also because its chemical qualities are such as especially favor herbaceous vegetation.

That some portions of the prairie soil may have been formed by the decomposition of aquatic plants in the manner suggested by Mr. Lesquereux we are not disposed to deny, although not aware that it has yet been proved by chemical investigation that such a soil is chemically unfitted to support the growth of forest trees. We are, however, still disposed to adhere to the statement made in the Wisconsin report (1862), that "the great mass of superficial clay, loam, and other loose materials lying on the solid rock in this region [the Lead Region of the Upper Mississippi, a prairie country] is simply the residuum left after the more or less complete solution and removal of the soluble portion of the rock."[2] That the prairie soil proper is not, as a general rule, or necessarily, a soil containing a large amount of organic matter, seems to us clear. A large quantity of such material does collect, it is true, in the swampy places and low swales between the ridges or swells of the prairies; but it must be remembered that the higher grounds — the divides between the streams — are *par excellence* the regions of prairie. And it would be extremely difficult to prove that these higher grounds have ever been occupied by an aquatic vegetation. The extensive district in Wisconsin and Minnesota which has never since almost the earliest period of geological time been covered by water,[1] and which is as far as possible from being of a swampy nature, is thoroughly a prairie region, as has already been described.

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[1] Geology of Illinois (1866) vol. i., chap. vii., Onthe Origin and Formation of the Prairies.

[2] See Wisconsin Report, chapter iii., on the Physical Geography and Surface Geology of the Upper Mississippi Lead Region, by the author of the present article.

The series of events in the course of which the detrital materials covering the greater part of the States bordering on the Mississippi have been distributed and arranged in their present position must have been a long and complicated one. We know that the ocean has had nothing to do with it, for not a trace of anything marine has ever been found in these deposits, while bones of land animals and fresh-water shells and plants are not unfrequently met with. When we consider that in going west from the Mississippi we rise to an elevation of more than a thousand feet above the river, while all the time the prairie soil maintains its character, it becomes evident that we cannot admit that deposition of this detrital matter took place in the same manner and at the same time from one vast area of fresh water. No possible barrier for this water could be found in any direction except to the west, for to have covered the whole prairie region its surface must have been nearly 2000 feet above the sea-level. Everything in the prairie region indicates the slow and, as a general rule, tranquil accumulation of detrital materials during a vast period of time, and as the result of agencies rather local than general, having more of a fluviatile than of a lacustrine character, and which must have been in operation for a long time before the glacial epoch commenced. The discussion, however, of the phenomena here alluded to would extend this paper far beyond any reasonable limits.

Those who are familiar with the geology of the Mississippi Valley will not need to be told that the prairie region is one underlain by undisturbed and nearly horizontally stratified rocks. They will remember that these rocks are chiefly limestones, dolomites, and shales, easily acted on by water, the bulk of the material being bodily removed in solution, and not left as a disin-

[1] See Wisconsin Report, page 118, et seq.

tegrated mass on the surface, as is the case with the harder metamorphic rocks. These are the conditions specially favorable to the development of prairies; and it is under these conditions that prairies, in the Western sense of the word, are usually met with.

A few words may be added for the benefit of those who are disposed to put confidence in the stories told by persons having land for sale at the West, in regard to the ease with which forest trees may be raised on the prairies, some even going so far as to maintain that building a fence and keeping out the prairie fires is sufficient tó insure the speedy covering of the land thus protected with a growth of timber. The best answer that can be made in a few words to these assertions is to quote from a pamphlet published by a practical man, Mr. Leonard B. Hodges, Superintendent of Tree Planting of the Saint Paul and Pacific Railroad Company. His object is to urge the importance to the West of raising forest trees; and does he say, "Fence in your land, gentlemen farmers, and your forests will develop themselves"? Quite the contrary; he especially dwells on the point that even setting out the trees will not answer, unless the land has been properly prepared. To use his own words, "without this thorough preparation, failure and disappointment are inevitable." So arduous a task is it to raise forest trees on the prairies that the State of Minnesota passed a law in 1871 granting a bounty of two dollars a year per acre for ten years and fot every acre planted with "any kind of forest trees except black locust;" and Congress has gone further by actually giving to any settler the land, to the extent of forty acres, on which he will maintain a growth of forest trees for ten years. These provisions will, we think, convince any one that raising timber on the prairies is not so very easy a matter, but rather something "going against the grain" of nature.

There are persons to whom the position of the plains with reference to the prairies will be a decided stumbling-block in the way of their acceptance of the views above advanced. They will say, "Do not the plains begin where the prairies leave off, and are not the latter simply the incipient stage of the former? Do we not find the amount of precipitation growing gradually less as we approach the Rocky Mountains in going from the Atlantic coast, and are not the prairies simply the result of this deficiency, manifesting itself in only a partial covering of the surface of the forests?" This does indeed seem very plausible as long as one has not examined carefully into the facts; let us conceive that what was set forth in the first portion of this article will have been abundantly sufficient to disprove the existence of this assumed want of moisture in the Mississippi Valley. If the drift agencies had covered the whole of the prairie States with coarse detritus, as they have the region to the north and northeast; then, in the opinion of the writer, forests would have clothed the whole country, as far west, perhaps, as the western border of Iowa; but from there on, no matter what the condition of the surface, they would not have extended themselves, because of the deficiency of moisture, the decrease being a very rapid one from the 94th meridian towards the west. On the other hand, there is nothing in the geological conditions of the surface in the region of the plains to prevent a forest growth, provided the climatological conditions were favorable, a complete change taking place in the character of the formations soon after we enter Nebraska and Kansas, the Cretaceous and Tertiary rocks covering up entirely all the older strata; and as they consist almost exclusively of coarse arenaceous materials, they furnish by their decomposition a soil very different from that of the prairies. If, again, the topography of the country was such that the warm and moist winds could not blow from the Gulf of Mexico up the valley of the Mississippi, causing as they go an abundant precipitation, then that region would be a sterile one, instead of being, as it now is, one of the most favored agricultural areas of the world, albeit not everywhere clothed with forests.

HYGIENE OF HOUSE PLANTS.

BY GEORGE H. PERKINS, PH. D.

ARE plants growing in occupied rooms injurious or beneficial to the health of the occupants? This is a question often asked and often answered in a very general manner; but it does not seem to be always easy to give specific reasons for a belief in the value or worthlessness of the influence of cultivated plants upon the air immediately about them. As full and satisfactory a reply to the question we have asked as can be given is of considerable importance, now that plants are found growing in a large majority of homes all over the country, and to furnish a reply is the object of this article. Although the writer is conscious that it is not by any means all that could be desired, he yet hopes that it may not be wholly useless to many lovers and cultivators of plants.

A group of plants is so attractive and so interesting in its form and development, that we would gladly be sure that its presence contributes as much to the health of a room as to its beauty. An entirely satisfactory investigation of this matter is scarcely possible, for analyses of air, careful experiments, and observations relating to the influence of plants growing in occupied rooms, are for the most part wholly wanting. The general effect of vegetation in the economy of nature is too wel known to be dwelt upon here. Most are familiar with the fact that animals are dependent upon plants for food, and that after growth, reproduction, and death, the materials of animal structure return to the vegetable, and thus everywhere, in ever-recurring cycles, the dead animal returns to life in the plant; everywhere, for vegetable life is everywhere, rooted in earth, floating in water, buoyed in air, and everywhere attractive, varied, and interesting. What is said in regard to plant life and growth in this article refers only to the higher and flowering plants. Such plants often remove much from both the earth and the air in which they grow, and in return they give much to the air; but while living they return almost nothing to the earth, only now and then a stray leaf or bit of branch. Hence, growing plants tend to change the nature of both soil and air. The chief processes of plant life, absorbing, assimilating, exhaling, are carried on with immense energy. *How* great these forces are we do not yet know, but experiments, such as those of President Clark, of Amherst, have lately been made, which have given us glimpses of the power exerted in vegetable growth. Without direct proof of the fact few would be ready to believe that the outward pressure of sap in a tree could ever equal that of a column of water over eighty feet high; that even in a bit of root wholly severed from the tree, though of course only recently cut off, the force of the sap-pressure could be as great, or that in a squash-vine it could equal that of a column of water nearly fifty feet high. No one, I think, would have supposed that a growing squash in its efforts to increase, would, when confined, lift a weight which was gradually increased to one ton, then to two tons, and finally to two tons and a half. These experiments are so well known that an account of them is unnecessary here, but they tell us very much of the forces acting in vegetation, which are so silent and imperceptible that we too often fail to notice them. In every field of growing grain chemical changes are taking place such as no chemist can produce; forces are in action which, if so directed, could heave and overturn the soil as by an earthquake. We are learning to look for power in its fullest development, not so much in the more noisy phenomena that all observe, as in those unobtrusive, noiseless processes, unseen save by the eye of science, that go on all about us. In raindrop and snowflake, in forming leaf and opening bud, we are taught to look for force greater than we can know. In the rush of a landslide, as it crushes and overturns everything in its way, all recognize vast power; but all do not know that in the growth of every tree that lies crushed in the pathway of those rock-masses more force was expended than would be needed to hurl them whence they came. It is well known that the leaves of plants exhale moisture, but it is not so well known how much various plants give to the air. The amount varies almost constantly, being affected by temperature, dryness of air, amount of light, and condition of the plant. But the amount of water given to the air during a season by plants, is very considerable. A French botanist found that an oak exhaled in one season eight and a half times as much water as fell in rain over an area equal to that of the leaves. And other similar experiments give similar results.

The well-known process of taking carbonic acid from the air and returning oxygen to it, fixing the carbon in the tissues of the plant, has been shown by Bernard and others to be a true digestive and assimilative process, while all the time a true respiratory process is carried on by which oxygen is taken and carbonic acid given out. During the day, when the leaves are subject to the action of light, both these processes go on, but the assimilative process is vastly the more energetic and conceals the other process wholly. When light is withdrawn the respiratory process comes into prominence, because of the almost or entire cessation of the other, so that the action of plants by night is said to be the reverse of that by day, and so it is practically; but it is to be remembered that the most vigorous and important action of the plant, that which alone exerts any very marked influence upon the surrounding air, is that by which carbonic acid is taken from the air and oxygen given back. The relative activity of these two processes varies at different times of the year, as Corenwinder has shown that when the leaves expand they contain a large proportion of nitrogenous matter, which decreases gradually until autumn, while as the leaves become fully developed the carbonaceous matter increases, at first rapidly, then more slowly, and after a time it remains fixed until towards autumn, when it decreases. So long as nitrogenous matter is in excess carbonic acid may be given off, but when the carbonaceous matter is in excess, whatever carbonic acid is set free is at once taken up by the chlorophyl and the carbon fixed, the oxygen being set free; and this latter is the great work of plants. So great are its effects that it is believed that they wholly counteract the vitiating influence of the billion pounds of carbonic acid which are, as is estimated, annually sent into the atmosphere; and throughout all the geological ages, since the development of plant life in its higher forms, it has been taking carbonic acid from the air, fixing the carbon and restoring the oxygen. Every pound of coal in all the two hundred thousand square miles of coal area in North America, represents three and two thirds pounds of carbonic acid taken from the air.

It can make but little difference where plants grow; those conditions which are essential to their growth must be met. If forests purify the air about them, it is reasonable to suppose that smaller groups of vegetation in our houses will purify that about them. There are indeed some plants that revel in filth and noisome vapors, but they are not such as will be found in our houses. Modern plants are many of them unable to endure even a slight increase in the amount of carbonic acid in the surrounding air, and we are forced to suppose that the plants of the coal period were peculiarly fitted for the atmosphere in which they grew. It has been found that many gaseous and other substances affect animals and plants in a similar manner, and in many cases an atmosphere in which one will not thrive is hurtful to the other. Many injurious gases that are too often found in our dwellings affect plants even more readily than they do man, so that to a certain extent plants become tests of the air we breathe; and when it is found that plants will not grow in a room because of gas from chandelier or furnace, it is surely true that such rooms are unfit for man's occupation, and that they cannot be used without certain injury to the health. In greenhouses, where a large number of plants are shut up in a small amount of air, it is true that the amount of carbonic acid is, even at night, less than outside. Florists, who spend much of their time in greenhouses, are as a class unusually healthy, and sometimes these people sleep for weeks in the greenhouse, with not the least evil effect. Physicians who have had much experience among florists have uniformly testified to their general robustness. It is also a well-known fact that asthmatic persons often find great relief as they enter a greenhouse and breathe its air; even those whose complaint prevents comfortable rest elsewhere find little or no trouble in sleeping in a greenhouse. Thus all the facts at our command tend to prove that the air of greenhouses, despite its exceeding dampness, is not unhealthy, but rather the reverse. Luxuriant vegetation growing in very moist air is not *necessarily* so unwholesome as is usually supposed. Mr. Bates, in The Naturalist on the Amazon, speaks of certain localities in which he spent some time, where the air was as if filled with steam at times, and always very full of aqueous vapor, and where the vegetation was wonderfully rank; and yet he found these places unusually healthy, free from many complaints common in drier regions near by. This is perhaps an exception, rather than an example illustrating a general rule, but it is worth some notice.

If house plants are to thrive, they must have abundance of fresh air and sunshine. And now that fine window plants are so generally desired, there is doubtless often a severe struggle in the mind of many a housekeeper, to decide whether the plants shall suffer and perhaps die, or upholstery and carpets be allowed to fade. The plants seem usually victorious, the windows are opened for more pure air, the shutters for more light, and the home becomes more cheery, attractive, and healthful. The air heated by stove, furnace, or worse, by steam-pipes, is almost sure to be very dry, so much so as to be irritating and hurtful to the respiratory organs. As has been noticed, the leaves of plants exhale moisture, often to a considerable amount, and a dry air, if brought into contact with growing plants, is furnished with some of the lacking aqueous vapor. This process is, to a certain extent, self-regulating, for the drier the air the more rapid is the exhalation from the leaves, while this decreases as the moisture of the air increases. Another effect which might have considerable influence upon greenhouse air, but would not amount to much in occupied rooms, where but few plants are kept, is their tendency to equalize the temperature. In most cases plants do not rise in temperature as quickly as does the air about them, and while the air grows warmer during the day, and is at its maximum several hours before sunset, plants go on increasing in temperature for some hours after the air has begun to grow cooler, and thus as the air cools the radiation from plants warms it, while during the day the exhalation of moisture tends to cool the air. Thus far we have considered vegetation only in its ordinary growth, but after this has continued until the plant has sufficient vigor, it produces flowers and fruit, unless it belong to one of the lower orders. Now the usual conditions may be somewhat changed; the temperature of the plant rises ten or more degrees above that of the surrounding air, and as flowers expand, carbonic acid passes off and oxygen is taken up, but in most cases this is not of such extent as to be important.

A greater effect is that of the odors which some flowers possess. We have very little positive knowledge of the nature of the perfumes of flowers. We know that powerful odors affect some persons unfavorably, at least at the time they are inhaled, causing nausea and faintness. We know that hydrocyanic acid and other deleterious substances exist in some odors, but I believe that all odors from plants which are known to contain injurious substances are disagreeable and repulsive. It seems possible at least that intense odors, such as that of the tuberose or many lilies, if inhaled for a long time would prove harmful, while the more mild odors are not so. There is very good authority for the assertion that many plants, such as the lemon, mint, hyacinth, heliotrope, mignonette, etc., when in bloom, in some way increase the quantity of ozone in the surrounding air, and are in this way beneficial. The common sunflower is said to be very useful in this way, and to do very much to counteract the effect of miasmatic vapors in its neighborhood. Those resinous odors which come from coniferous trees are agreeable to every one, and are generally believed to be wholesome and remedial. The blue-gum (*Eucalyptus*) of Australia emits camphorated and antiseptic vapors which have been found of great value in malarial regions. On the whole it seems probable that the perfumes of most of our house plants are not very powerful for either good or evil, but that they are quite as likely to be beneficial as the reverse. If decaying leaves or other such débris are allowed to remain on the surface of the pots, they may vitiate the air; but aside from this it is not probable that injurious gases can come from decomposing material in the earth of the pots, for the plant and the earth together act vigorously to prevent any such thing.

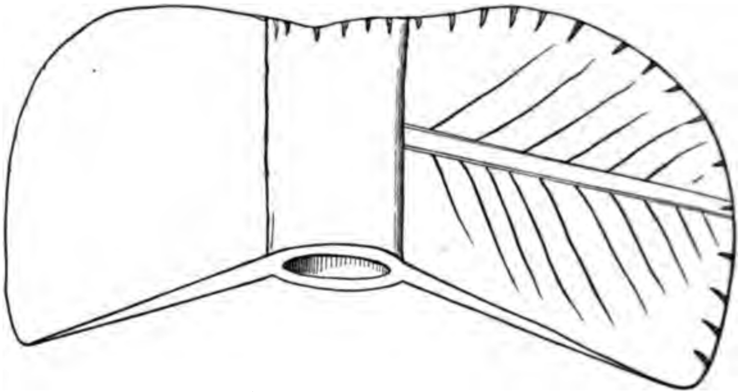
We conclude, then, that house plants are injurious only as they increase the carbonic acid in the air, and as they give out injurious perfumes. We have found that the first of these effects is certainly far more than counterbalanced by the taking up of carbonic acid and the throwing out of oxygen, and the second is also probably fully neutralized. House plants are positively useful, as they pour aqueous vapor into dry air, as they demand plenty of light and air, and on this account many a room, otherwise dark and unwholesome, is well lighted and aired. One of the most powerful and important influences of cultivated plants yet remains to be noticed. Thrifty plants are always beautiful, and their growth and development always instructive and interesting; and the constant presence of such objects in our homes is obviously of very great value. We learn to love a favorite plant, and its influence makes our lives gentler and less gross and material; we may not always appreciate this effect, but it is ever acting and ever powerful. Hence, were there no appreciable physical good to come from the groups of plants that are so commonly seen in our windows, this moral benefit should make us encourage in every way their cultivation, and rejoice that it is already so general.

AN ANCIENT SCEPTRE.

BY C. C. ABBOTT M. D.

WHILE the Indians were in undisturbed possession not only of the Atlantic coast of North America, but of a great part, if not the whole, of the interior, they were not politically one people, but divided into many tribes, some of these again being in league, as the Iroquois "nation." These political divisions and subdivisions indicate necessarily the prevalence of rank, and the authority of certain individuals over large and small communities; this again leads to the necessity of badges, or insignia of office. Now among the many relics of the red man that we gather from our fields there occur some specimens which would be veritable puzzles, were it not that we do know something of the past history of the Indians. Among these peculiar forms is that called here a sceptre (Figure 60). These vary much in outline, yet preserve sufficient uniformity to warrant our classifying them as one form.

In many archæological works, and shorter essays on the relics of a circumscribed locality, this exclusively North American pattern is called a perforated ax, a term which for many reasons I believe to be entirely inapplicable; for there has yet to be discovered a single specimen that is adapted to cutting any substance as hard as wood. If any tool, it is a knife for skinning and allied uses; but as an abundant supply of stone implements occur, the world over, that are known to be knives, hatchets, adzes, and axes, it is beyond question that these perforated specimens of stone work are either simply ornaments or badges of office. My reasons for believing them to be the latter are, as already stated, their comparative rarity, the absence of all indication of their having been put to any use whereby portions of the surface are worn or chipped off, and thirdly, that when found in graves they are associated with other elaborate relics, that of themselves give evidence of the rank of the person buried.



(FIG 60.) ANCIENT INDIAN SCEPTRE.

The variation of form, too, may be mentioned as indicative of the ornamental or badge-like character of the implement, the shape of the "wings" never approaching a tool-like appearance, but varying in the direction of the fantastic,[1] so that many are miniature pickaxes, or double picks. On the other hand, the central tube may be quite long, and the broad "wings" give the specimen a heart-shaped outline. Such specimens, however, may really not be sceptres, but winged medicine tubes, that the Indian physician used in sucking or blowing away the disease afflicting his patient.

The specimen here figured is doubly interesting, from the fact that one portion is scored with a series of notches about its margin, which add, I consider, great weight to the suggestion that these implements are banner-stones, or badges. I prefer the term "sceptre." Marginal notches such as here shown in Figure 60 are records of some one event, frequently repeated; in this case, possibly of successful wars with a hostile tribe, or of the personal prowess of the owner of the badge. The additional ornamentation, simulating the veining of a leaf, too, may have some such meaning.

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[1] Stevens's Flint Chips, American edition, page 506.

An interesting fact in relation to this form of Indian relic is that it is quite as characteristic of the Mound-Builders as of the Atlantic coast natives. As it is a peculiar form of stone implement, and not one that is likely to occur with two widely separated and very different races, it argues a nearer relationship of the Mound-Builder and the Indian than is supposed by many to have existed.

In the specimen here figured[1] we see a highly polished and nearly symmetrical worked stone, suggestive of no domestic use, and valueless as a weapon or hunting implement. Its whole appearance indicates that a vast amount of labor has been expended upon it; furthermore, it is quite elaborately ornamented. Again, the perforation shows that it was mounted upon a slender handle, and thus wielded it becomes intelligible as an indication of the superior rank of its possessor — possibly a veritable sceptre in the hands of a prehistoric American king.

THE GREAT SALT LAKE IN FORMER TIMES.

THE Great Salt Lake of Utah was discovered in 1833 by Captain Bonneville, although his account of it was not published until ten years later by Washington Irving in The Adventures of Captain Bonneville, U. S. A., in the Rocky Mountains and the Far West. It was more fully described afterwards by Frémont and Stansbury, though but little light has been thrown upon the early history of the lake, until within a few years. In his report on the geology of Wyoming and contiguous Territories, for 1870, Dr. F. V. Hayden thus describes the lake beds and appearance of Great Salt Lake in the Quaternary Period: —

"If now we pass to what may be called for convenience the quaternary period, or the one that gradually merges into the present, we shall find that it presents geological features of no ordinary interest. In descending the Weber Valley, after we emerge from the cañon of the Wahsatch range into the open valley of Salt Lake, we observe on either side thick beds of sand and arenaceous clays, which must have been deposited in the quiet waters of a lake. In the valley of Salt Lake, and especially in that of the Weber River, these drift deposits possess a thickness of several hundred feet, and of these materials the terraces are formed. Near Salt Lake City, in digging a well, fresh-water shells were found in these deposits, forty feet below the surface; and on the north side of the lake, where these deposits are very largely exhibited, the cuts in the railroad, through the gravel and sands, reveal the greatest abundance of fresh-water shells, showing that at this time the physical conditions were unusually favorable for the existence of fresh-water molluscous life. So far as I could ascertain, these conditions do not exist at the present time, or if they do, it must be only to a limited extent. From these observations I infer that a vast fresh-water lake once occupied all this immense basin; that the smaller ranges of mountains were scattered over it as isolated islands, their summits projecting above the surface; that the waters have gradually and slowly passed away by evaporation, and the terraces are left to reveal certain oscillations of level and the steps of progress toward the present order of things; and that the briny waters have concentrated in those lake basins, which have no outlet. The entire country seems to be full of salt springs, which have, in all probability, contributed a great share to the saline character of the waters."

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[1] This specimen was found by Prof. S. S. Haldeman, in an island in the Susquehanna River, Pennsylvania. The illustration is a reproduction of a pen-sketch, in a letter to the author, referring to Indian relics found in Pennsylvania.

Additional information concerning the geology of the lake has recently appeared in the report of Mr. G. K. Gilbert, of Wheeler's Survey of the Territories West of the One Hundredth Meridian. We shall attempt, with the aid of liberal extracts from this interesting report, to give some account of the ancient history of this great briny lake, which in past ages extended over such a large area and formed one of a series of vast inland lakes rivaling in size the present great lakes of the northern border of the United States. These ancient lakes lay in the depressions of the Great Basin, as it was called by Frémont, situated between the Rocky Mountains and the Sierra Nevada.

The Great Salt Lake occupies the eastern portion of the Great Salt Lake Desert, which is divided from the Sevier Desert by a series of low ranges. These hills or insular buttes appear to have been, as it were, submerged beneath a sea of detritus. "If these hidden mountains rise as high above their bases as do their neighbors on the rim of the basin, we may, by comparing summits with summits, learn something of the relative depression of the rocky bottom of the basin below its margin; and it would appear, judged in this manner, to be not less than four thousand feet. And, on the same supposition, the desert sediments, which, before burying the mountain ridges, have filled the intermediate valleys, may have a maximum thickness of five thousand or six thousand feet. Their upper surface, water-laid and smooth, is the broad floor of the desert, from which arms stretch north and south between the fringing mountains. In longitude the plain measures a little over a hundred miles, and in latitude a little less. Its general level is about 4200 feet above the ocean, and Great Salt Lake probably occupies its greatest depression, though lying close to its eastern border. Its surface material is a fine adhesive, absolutely sterile clay, charged with chloride of sodium and other soluble salts, the deposit from the last expansion of the waters of the lake, an expansion so recent that the beach-lines formed at its culmination and during its slow subsidence are perfectly preserved on the shores of the desert.

"The eccentric position of the lake is evidence of the novelty of the present relation of altitudes of different portions of the plain, which is far from an equilibrium. Nearly the whole present increment to the desert floor comes from beyond the Wahsatch Mountains, and is deposited in the deltas of the Jordan, Weber, and Bear rivers, on the eastern margin of the lake. Since the lake has no outlet, but parts with its surplus by evaporation, its area rather than its level tends to constancy; and, as the eastern shore increases, the water will rise, *pari passu*, and encroach on the western. The continuation of this process, if there is no counter influence, such as a secular depression of the lake basin, will push the water, in a few thousand years, to the western side of the desert."

Having considered the lake as it is at present, let us look at its past history as elucidated by Mr. Gilbert. He considers, from a study of the sediments and ancient beaches, that the Great Salt Lake formerly included the valleys now occupied by Sevier and Utah lakes, and he calls the hypothetical ancient body of water Lake Bonneville. "The most conspicuous traces of Lake Bonneville are its shore-lines. At their greatest expanse the waters rose nearly one thousand feet above the present level of Great Salt Lake, and at this and numerous other stages marked their lingerings by elaborate beaches and terraces. These are very conspicuously displayed on the slopes of the Wahsatch range near Great Salt Lake, and on the rocky islands of the lake, and have attracted the attention of every observant traveler from the time of the explorations of Frémont and Beckwith. All the varied products of wave-work, as we know them on modern shores, are represented and beautifully preserved."

The ancient beaches, or "benches" as the inhabitants call them, which indicate the former levels of the lake, at once attract the attention of the traveler soon after he leaves Ogden for Salt Lake City. "While some of the benches are better marked than others, no number can be assigned to the successive shore-lines from the highest to the modern. Upon gentle slopes many more can be detected than on steep, and they are of all grades of distinctness. It is doubtless true that some, which are at certain stations conspicuous, as compared to others, are elsewhere, from local causes, inconspicuous; but there are two lines that can, at nearly every point, be recognized as far more strongly traced than any others. One of these is the highest of all, the Bonneville beach. The other occurs about three hundred feet lower, and this we have found it convenient to entitle the Provo beach, drawing the name from the town of Provo, on the shores of Utah Lake, near which it is especially well exhibited. These tell us that, during the progressive subsidence recorded by the entire series, there have been two marked epochs, perhaps many thousands of years in duration, through each of which a constant water level was maintained. The level of Great Salt Lake, like that of other lakes without overflow, is notoriously inconstant, for the obvious reason that it depends on the ratio between precipitation and evaporation over a limited area, factors which diverge, and change their conditions of equilibrium, with every fluctuation of annual mean temperature or humidity. It is difficult to imagine that so unstable a climatal equilibrium was maintained for the time that was consumed in the production of either the Bonneville or the Provo beach, and, before we accept such explanation of their origin, we are led to inquire whether at these levels the stage of water was not regulated by an overflow. The coincidence of one of the constant levels with the highest water stage of all renders the presumption of an outflow at that stage especially strong. With these considerations in view, we endeavored, in tracing the outline of the lake, to discover its point of discharge, but without success. Our examination was almost exclusively confined to the southern half of the lake, and points to the conclusion that no outlet existed toward the Colorado River. At one low point of the southern rim, near Hebron, Utah, the observation was not so complete as was to be desired, and the question may be considered as not definitely settled. Prof. O. C. Marsh informs me that he has discovered, on the northern shore of the lake, an outlet leading to the Snake River, but I am not aware at what point, nor at what altitude. The northern portion of the lake area falls within the fields of study of the corps of Mr. King and Dr. Hayden, and when their observations and those of Professor Marsh shall have been published, the relation of the beaches to the outlet or outlets will doubtless be known. Meantime I anticipate that the Provo beach, as well as the Bonneville, will be found to have been determined by an overflow.

"The largest open body lay over the Great Salt Lake Desert, and had a depth of about nine hundred feet. The average depth of the whole was not far from four hundred feet, and the extreme depth one thousand feet. Its area was not far from eighteen thousand square miles, being a trifle less than that of Lake Huron, and eight times as great as Great Salt, Utah, and Sevier lakes combined. Its extreme length, from north to south, was about three hundred and fifty miles, and its width one hundred and twenty-five miles."

Mr. Gilbert then describes the beds containing shells deposited by this ancient lake, and discusses the question whether the lake was originally fresh or brackish. The deposits formed by the lake "are largely composed of fine, friable, white calcareous marl, and this passes, on the one hand, into a cream-colored, partly oölitic sand, of calcareous and silicious grains, feebly cemented by calcite, and, on the other, into an impalpable clay charged with chloride of sodium and other soluble salts. All of these beds, excepting the most saline of the clays, are fossiliferous, affording, in great abundance, a few species of lacustrine gasteropoda." The area covered by these beds is completely circumscribed by the Bonneville beach. "Of the history of the beach, or, what is the same thing, of the history of the lake, we know only the last few pages. We know that the present low tide has been preceded by a high tide, the duration of which, though extended, was not unlimited, and we know that for a comparatively long antecedent period there had been no similar flood; but we do not know that there were or were not earlier floods; nor can we tell how low was the stage from which the water rose to its last maximum." The author thinks that the lake basin was filled by the melting of glaciers. As regards the water of Lake Bonneville, Mr. Gilbert seems to be in doubt whether it was fresh or salt, the evidence derived from both the fossils and the beds themselves being vague. The shells contained in the beds, he thinks, may have been borne into the lake by streams, and there is an absence of any fresh-water mussels (*Unio*, etc.). "The salt," however, which is so prominent a characteristic of the present Sevier and Great Salt lakes, and abounds in all the later sediments of the shrunken ancient lake, is nearly absent from the beds most clearly associated with the upper beach; and its distribution indicates that Lake Bonneville, if not perfectly fresh, was at least far less saline than either Great Salt or Sevier Lake." Again, farther on, Mr. Gilbert inquires whether "the basin contains the amount of salt which would have sufficed to render the great lake briny. The ancient volume was no less than three hundred times greater than that of Great Salt Lake (when surveyed by Captain Stansbury), and the brine of the latter, so greatly diluted, would give only one thirteenth of one per cent. of salt. But if we add to the salt of Great Salt Lake that of Sevier Lake, and the far greater but indeterminate quantity accumulated in the sediments of the lower parts of the two deserts, we shall probably have enough to give Lake Bonneville, if it were undrained, the salinity of the ocean. In fine, we are led to believe that, while Lake Bonneville certainly held less salt than do its modern representatives, its recorded phenomena comprise no fact that places it definitely among either fresh or salt lakes." As bearing on the question whether the ancient Bonneville Lake was salt, brackish, or fresh, and whether the shells in the Bonneville beds lived in the waters of the lake itself and not alone in the tributary streams, we may cite the case of Lake Tanganyika, whose outlet has been discovered by Lieutenant Cameron. This explorer in his diary [1] in one place says, "Such an amount of water comes into the lake, and there are no signs of change of level, so that it seems impossible to dispose of all the surplus water by evaporation; besides which, so many streams run through salt soil that, if it were disposed of in that way, the lake would be as salt as brine." Again he says, "The whole country was at one time an enormous lake; . . . . of this sea, most probably a fresh-water one, Tanganyika, the Nyanzas, and the Livingstone lakes are probably the remains. It may have been salt, witness salt soil of Uvinza and Ugaga, and freshened by the continual rain-fall of thousands of years." Farther on he says, "The Lukuga *is* the outlet if any; it tastes the same as the Tanganyika, slightly salt (not salt, but peculiar), and *not* fresh, like the other rivers."

Have we not here a parallel between the present Lake Tanganyika on the African plateau, with its outlet the Congo, and the ancient Lake Bonneville, with its former outlet flowing either north or south or in both directions? Judging by the fossil shells so abundant in the Bonneville beds they must, it seems to us, have lived in the lake itself, for it is well known that brackish lakes and inlets support fresh-water molluscs and fish. Is it not probable that the ancient Great Salt Lake was once simply brackish, and that when, owing to the desiccation of the continent, its outlet or outlets dried up and the lake contracted, it became gradually saline?

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[1] Journal of the Royal Geographical Society, 1875, pp. 202, 210, 227.

As regards the supposed former outlet of Great Salt Lake, Mr. Gilbert supports the views of Professor Marsh and Bradley that the outlet was towards the north, into the Snake River Valley. Great Salt Lake was, Mr. Gilbert adds, but one of a group, as others must have filled the valleys of the Great Basin. "In the list of those which overflowed may probably be included all of the northern tier, bordering on the present drainage system of the Columbia River, and those which, lying at the feet of the Wahsatch range and the Sierra Nevada, received the streams from those mountains. What we know of the Death Valley and other southwesterly basins tends to show that they were not entirely filled.

"Of the interesting group of lakes that along the base of the Sierra Nevada survive the general desiccation, our route touched but one, and that the most southerly. Owen's Lake lies in a trough between the Sierra Nevada at the west, and the Inyo and Coso ranges at the east, and receives its water from Owen's River, which, rising seventy miles at the north, follows the trough and accumulates the streams from the adjacent mountains. It now contains a strong brine, and is without outlet, but it is surrounded by ancient beaches, and in the sands of the most elevated of these are abundant specimens of *Anodonta*, testifying to its former freshness. Its ancient area did not exceed its modern by more than one or two times, and the channel through which its surplus discharged is distinctly marked." — A. S. PACKARD, JR.

RECENT LITERATURE.

ORTON'S ANDES AND THE AMAZON.[1] — This is the work of a naturalist as well as a traveler, and presents a lively and, so far as we are aware, an entirely truthful account of the wonderful regions on each side of the Andes of Peru. Though the scientific results of the two expeditions across the Andes and down the Amazons have been published elsewhere, those of more popular interest are introduced into the narrative. The third edition contains much new matter, with a new map of the Marañon region, "a vast and interesting country, most rudely laid down on existing maps." The author also presents "facts illustrating the commercial resources and possibilities of the Valley of the Amazons, a subject which is destined to arrest the attention of enterprising men and nations." The present edition has been prepared by adding to the narrative of the expedition of 1867 a description of a more southerly route. The book is copiously and well illustrated, and describes a course of travel which will prove very attractive to tourists.

WILSON'S PREHISTORIC MAN.[2] — This standard book has passed into a third edition, in which "much of the original work has been rewritten. Several chapters have been replaced by new matter. Others have been condensed or recast, with considerable modifications and a new arrangement of the whole." The illustrations are abundant and excellent, a number of new ones having been engraved for this edition.

Commendation of such a work, so long and favorably known to the public, is scarcely necessary. A few points seem to us open to correction. For example, on page 34 (vol. i.) the author allows the following statement to appear: "Fossil human remains have also been recovered from a calcareous conglomerate of the coral reefs of Florida, estimated by Professor Agassiz to be not less than ten thousand years old." This estimate is worthless, as may be seen by a note in the NATURALIST (ii. 443) by Count Pourtales, the original discoverer of the bones. He says, "The human jaw and other bones found in Florida by myself in 1848 were not in a coral formation, but in a fresh-water sandstone on the shore of Lake Monroe, associated with fresh-water shells of species still living in the lake (*Paludina*, *Ampullaria*, etc.). No date can be assigned to the formation of that deposit, at least from present observation."

Professor Wilson is cautious in accepting the evidence of the high antiquity of man, rather more so than the majority of leading anthropologists.

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[1] *The Andes and the Amazon; or, Across the Continent of South America.* By JAMES ORTON. Third Edition, revised and enlarged, containing Notes of a Second Journey across the Continent from Para to Lima and Lake Titicaca. With two Maps and numerous Illustrations. New York: Harper and Brothers. 1876. 12mo, pp. 645.

[2] *Prehistoric Man.* Researches into the Origin of Civilization in the Old and New World. By DANIEL WILSON. Third Edition, revised and enlarged. With Illustrations. In two volumes. London: Macmillan & Co. 1876. 8vo.

RECENT BOOKS AND PAMPHLETS. — A Course of Practical Instruction in Elementary Biology. By T. H. Huxley, assisted by H. N. Martin. Second edition, revised. London and New York: Macmillan & Co. 1876. 12mo, pp. 279. $2.00.

Manual of the Vertebrates of the Northern United States, including the District east of the Mississippi River and North of North Carolina and Tennessee, exclusive of Marine Species. By David Starr Jordan. Chicago: Jansen, McClurg, & Co. 1876. 12mo, pp. 342. $2.00.

Report on the Geology of the Eastern Portion of the Uinta Mountains and a Region of Country adjacent thereto. With Atlas. By J. W. Powell. Washington. 1876. 4to, pp. 218.

Recherches sur les Phénomènes de la Digestion et sur la Structure de l'Appareil digestif chez les Myriapodes de Belgique. Par Félix Plateau. Bruxelles. 1876. 4to, pp. 94.

Note sur une Sécrétion propre aux Coléopteres Dytiscides. Par Félix Plateau. Bruxelles. 1876. 8vo, pp. 10.

Note sur les Phénomènes de la Digestion chez la Blatte américaine (*Periplaneta Americana* L.). Par Félix Plateau. Bruxelles. 1876. 8vo, pp. 30.

Proceedings of the Davenport Academy of Natural Sciences. Vol. i. 1867–1876. Davenport, Iowa. 8vo. pp. 294. With 36 Plates. $2.50.

Recent Explorations of Mounds near Davenport, Iowa. By R. J. Farquharson, M. D. (From the Proceedings of the American Association for the Advancement of Science, 1875.)

A List of Orthoptera collected by J. Duncan Putnam during the Summers of 1872–3–4 and 5, chiefly in Colorado, Utah, and Wyoming Territories. By Dr. Cyrus Thomas. (From the Proceedings of the Davenport Academy of Natural Sciences, vol. i.) Davenport, Iowa. June, 1876. 8vo, pp. 20.

Entomologischer Kalender für Deutschland, Oesterreich und die Schweiz auf das Jahr 1876. Herausgegeben von Dr. F. Katter. Putbus. 1876. 12mo, pp. 107.

On the Anatomy and Habits of *Nereis virens*. By F. M. Turnbull. (From the Transactions of the Connecticut Academy, vol. iii. August, 1876.) 8vo, pp. 15. With three Plates.

Rambles of a Naturalist in Egypt and other Countries. By J. H. Gurney. London: Jarrold and Sons. 12mo, pp. 307.

GENERAL NOTES.

BOTANY.[1]

ALFRED W. BENNETT ON THE GROWTH OF THE FLOWER-STALK OF THE HYACINTH. — (Abstract of a paper read before the Linnean Society, London, March, 1876.) In a paper read to the society at its meeting on November 4, 1875, Mr. Bennett gave some details in respect of the remarkably rapid growth of the flower-stalk of the female flower of *Vallisneria spiralis*. The general results arrived at were that the greatest "energy of growth" was displayed by the apical portion of the peduncle or that immediately beneath the flower-bud, the energy apparently decreasing regularly towards the base of the flower-stalk. As this appeared to be opposed to the law stated by Sachs and others to govern the rate of growth of the different successive internodes of an aerial stem, he was anxious to ascertain how far it was in accord with the relative rapidity of growth of different portions of a single elongated aerial internode. For this purpose he measured the growth of the common peduncle of the inflorescence of the hyacinth, with the following results in two specimens, one grown in a hyacinth-glass, the other in soil in a pot.

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[1] Conducted by PROF. G. L. GOODALE.

Specimen A, grown in a hyacinth-glass. This was first measured at noon on February 23d, when the peduncle, with a total length of 1.25 in., was divided into two equal portions of 0.625 in. At 10 A. M. on the 26th, when it had increased to 1.55 in., each of the two sections was again divided, the length of the four portions, proceeding from above downwards, being 0.35, 0.4, 0.4, and 0.4 in. Measurements were made twice and sometimes three times a day; and it was soon evident that the energy of growth of these different portions was very unequal. By ten P. M. on February 29th each of the three uppermost portions was still only 0.5 in. long, whilst the lowest had increased to 1.0 in. From this time the increased rapidity of growth of the lowest portion was still more marked. By ten P. M. on March 5th the lengths were respectively 0.9, 0.9, 0.85, and 2.35 in., and at ten P. M. on March 11th, when the growth had finally ceased, the measurements were 1.15, 1.0, 1.0, and 3.45 in., making a total of 6.6 in. The following is a complete table of the measurements: —

	A.	B.	C.	D.	Total.	Increase.
Feb. 26th, 10 A. M.	.35	.4	.4	.4	1.55	..
12 noon	.35	.4	.4	.45	1.6	.05
10 P. M.	.35	.4	.4	.5	1.65	.05
27th, 1 P. M.	.4	.4	.4	.55	1.75	.1
10 P. M.	.4	.4	.4	.55	1.75	.0
28th, 10 A. M.	.45	.4	.4	.65	1.9	.15
3 P. M.	.45	.4	.4	.7	1.95	.05
10 P. M.	.45	.45	.4	.75	2.05	.1
29th, 10 A. M.	.5	.45	.45	.8	2.2	.15
3 P. M.	.5	.5	.45	.95	2.4	.2
10 P. M.	.5	.5	.5	1.0	2.5	.1
March 1st, 10 A. M.	.55	.55	.5	1.2	2.8	.3
10 P. M.	.6	.55	.5	1.25	2.9	.1
2d, 10 A. M.	.65	.6	.55	1.3	3.1	.2
6 P. M.	.7	.65	.55	1.35	3.25	.15
3d, 10 A. M.	.75	.65	.6	1.5	3.5	.25
3 P. M.	.75	.7	.6	1.7	3.75	.25
10 P. M.	.8	.7	.6	1.9	4.0	.25
4th, 10 A. M.	.8	.75	.75	2.2	4.5	5
10 P. M.	.85	.8	.8	2.3	4.75	.25
5th, 10 A. M.	.85	.8	.8	2.3	4.75	.0
10 P. M.	.9	.9	.85	2.35	5.0	.25
6th, 10 A. M.	.95	.9	.9	2.5	5.25	.25
10 P. M.	1.0	.9	.9	2.7	5.5	.25
7th, 10 A. M.	1.0	.9	.9	2.75	5.55	.05
10 P. M.	1.0	.9	.95	2.9	5.75	.2
8th, 10 A. M.	1.05	.9	1.0	3.0	6.0	.25
10 P. M.	1.1	1.0	1.0	3.15	6.25	.25
9th, 10 A. M.	1.1	1.0	1.0	3.2	6.3	.05
11 P. M.	1.15	1.0	1.0	3.25	6.4	.1
10th, 10 A. M.	1.15	1.0	1.0	3.4	6.55	.15
10 P. M.	1.15	1.0	1.0	3.45	6.6	.05
11th, 10 A. M.	1.15	1.0	1.0	3.45	6.6	.0

It will be seen from the above table that by far the greatest total energy of growth was displayed by the lowest of the four segments, which increased during the twelve days between February 26th and March 10th from 0.4 to 3.45 in., or 762.5 per cent. of its original length. The next greatest energy, but at a great interval, was exhibited by the apical section, which increased from 0.35 to 1.15, or 228 per cent., while the two central portions exhibited the least activity, increasing only from 0.4 to 1.0, or 150 per cent. of their original length.

Specimen B, grown in a pot. In the second example, the evidence was still more conclusive that the growth of the peduncle is mainly basilar. On February 26th, the flower-stalk, then an inch in length, was divided into two equal portions of 0.5 in. On the next day, when it had increased to 1.1 in., the lowest zone of 0.1 in. was marked off separately. By ten P. M. on February 29th this lowest zone (C+D) had increased to 0.7 in., or by 600 per cent. of its original length, while the two uppermost zones were still respectively only 0.55 and 0.5 in. long. The lowest zone was then again divided into two portions, the upper one being 0.5 and the lower 0.2 in. long. By ten P. M. on March 3d the lengths of the four zones, commencing from the top, were 0.8, 0.8, 0.75, and 0.75 in., giving a total of 3.1 in. At ten P. M. on the 7th, the total length of 6.5 in. was distributed thus: 1.6, 1.5, 1.25, and 2.15 in.; and at ten A. M. on the 13th, when the final length of 8.2 inches had been attained, the measurements were respectively 2.2, 1.75, 1.5, and 2.75 in. The following is the complete table: —

	A.	B.	C.	D.	Total.	Increase.
Feb. 26th, 9 A. M.	.5	.5	..	..	1.0	..
10 P. M.	.5	.5	..	..	1.0	.0
27th, 1 P. M.	.5	.55	..	..	1.05	.05
10 P. M.	.5	.5	.1	..	1.1	.05
28th, 9 A. M.	.5	.5	.2	..	1.2	.1
3 P. M.	.5	.5	.2	..	1.2	.0
10 P. M.	.5	.5	.2	..	1.2	.0
29th, 9 A. M.	.55	.5	.45	..	1.5	.3
10 P. M.	.55	.5	.5	.2	1.75	.25
March 1st, 10 A. M.	.55	.55	.5	.3	1.9	.15
10 P. M.	.6	.55	.55	.3	2.0	.1
2d, 9 A. M.	.6	.6	.55	.4	2.15	.15
6 P. M.	.65	.6	.55	.5	2.3	.15
3d, 10 A. M.	.65	.65	.65	.6	2.55	.25
3 P. M.	.75	.75	.65	.65	2.8	.25
10 P. M.	.8	.8	.75	.75	3.1	.3
4th, 10 A. M.	.9	.9	.8	1.1	3.7	.6
10 P. M.	.9	.9	.85	1.25	3.9	.2
5th, 10 A. M.	1.0	1.0	1.0	1.25	4.25	35
10 P. M.	1.05	1.1	1.1	1.25	4.5	.25
6th, 10 A. M.	1.2	1.25	1.1	1.55	5.1	.6
10 P. M.	1.35	1.3	1.2	1.75	5.6	.5
7th, 10 A. M.	1.5	1.5	1.25	1.85	6.1	.5
10 P. M.	1.6	1.5	1.25	2.15	6.5	.4
8th, 10 A. M.	1.65	1.5	1.25	2.15	6.55	.05
10 P. M.	1.7	1.55	1.35	2.15	6.75	.2

	A.	B.	C.	D.	Total.	Increase.
9th, 10 A. M.	1.85	1.6	1.4	2.15	7.0	.25
11 P. M.	2.0	1.65	1.4	2.35	7.4	.4
10th, 10 A. M.	2.0	1.65	1.4	2.45	7.5	.1
10 P. M.	2.0	1.65	1.4	2.45	7.5	.0
11th, 10 A. M.	2.0	1.65	1.45	2.55	7.65	.15
12th, 10 A. M.	2.15	1.7	1.5	2.75	8.1	.45
10 P. M.	2.15	1.7	1.5	2.75	8.1	.0
13th, 10 A. M.	2.2	1.75	1.5	2.75	8.2	.1
10 P. M.	2.2	1.75	1.5	2.75	8.2	.0

Starting from the measurement at ten P. M. on February 27th, the lowest of the three zones, which then measured 0.1 in., had increased by March 13th so as to make up the two zones C and D together 4.25 in., or 4150 per cent. of its original length, while the remainder had only increased from 1.0 to 3.95, or at the rate of 295 per cent. Again, starting from ten P. M. on March 29th, when the four zones were first marked off, the ultimate increase of the lowest was from 0.2 to 2.75 in., or 1275 per cent.; the next greatest energy was displayed by the uppermost, which increased from 0.55 to 2.2, or just 300 per cent.; next came the second zone from the top, which showed an increase from 0.5 to 1.75, or 250 per cent.; and finally the third from the top, showing an increase from 0.5 to 1.5 in., or exactly 200 per cent. The rate of growth was again subject to great irregularities, which were no doubt attributable mainly to changes in temperature. Making the division between day and night as before at ten A. M. and ten P. M., the total amount of growth was again not very different in the two; but instead of being, as in the previous case, slightly in favor of the day, was rather more decidedly in favor of the night; of the 6.5 in. growth from February 29th to March 13th, 3 inches was by day, and 3.5 inches by night.

It will therefore be seen that, as far as these observations on the relative growth of different portions of the same internode go, they are entirely in accord with the statement of Professor Sachs, in regard to that of different internodes on the same branch, that the maximum energy of growth is exhibited at a period considerably below the *punctum vegetationis*, though it is here much nearer the base than in the cases measured by Sachs. This brings out into still stronger relief the opposite phenomenon displayed by the elongated submerged flower-stalk of *Vallisneria*, the energy of growth of which is manifested mainly in the apical portion. The elongation of the peduncle of the hyacinth continues considerably after the complete expansion of the flowers, until the lowest in the raceme begin to fade.

These observations differ in several points from those on the flower-stalk of the hyacinth recorded by Münter in the *Botanische Zeitung* for February 24, 1843. He describes its growth as not centrifugal, like that of most flower-stalks, but centripetal; that is, it ceases to grow first near the flower and finally at the base. It will be seen that Mr. Bennett's two experiments agree in this, that while the energy of growth is greatest in the basal portion, the apical portion continues to grow for very nearly or quite as long. The growth of the flower-stalk of *Pelargonium* he describes, on the other hand, as centrifugal, the growth of each zone ceasing before the one next above it.

With regard to the relative amount of growth by day and by night, Münter also gives no measurements, but states that in the daytime the plant grows at first five times, then four times, and then three times stronger than by night. This differs materially from the general law as stated by Sachs (Text-Book, English edition, page 749), that "the plant will, according to circumstances, sometimes grow more quickly by day, sometimes by night, without exhibiting any exactly recurrent periodicity," the difference, however, being never so great as that stated by Münter. Mr. Bennett's observations are more in accordance with this.

BOTANICAL PAPERS IN RECENT PERIODICALS. — *Comptes rendus*, No. 4. Trécul, Theory of Metamorphosis of Branches for Diverse Functions. Decaisne, Note on *Cedrela Sinensis*. Henneguy, On Reproduction in Volvox. No. 5. Trécul, On *Mentzelia*. J. Joubert and Chamberland, On Fermentation in Fruits kept in Carbonic Acid. Durin, On Cellulosic Fermentation. Béchamp, On the Microzymas of Germinating Barley and of Sweet Almonds, as producing Diastase and Synaptase. No. 6. Renault, On *Neuropteris*.

Flora, No. 22. Weiss, On the Relations of Growth, and the Course of Fibro-Vascular Bundles in *Piperaceæ*. (Continued also in Nos. 23 and 25.) No. 23. De Thümen, Fungi of South Africa. Nylander, On Certain Lichens in Mr. Wright's Cuban Collection (40 new species). No. 24. Dr. Christ, of Basel, Varieties of *Rosa*. Geheeb, Notes on Mosses.

Botanische Zeitung, No. 35. H. Hoffmann, Experiments in the Cultivation of Varieties. (Continued in No. 36.) V. Vesque-Püttlingen, On the Periodicity of the Currents in Protoplasma.

ZOÖLOGY.

THE PILOT FISH. — Eleven years ago, while on a voyage from India to this country, we were beset by many calms while crossing the "line." On one of these occasions, while some of the passengers were amusing themselves looking over the stern of the vessel, two beautiful pilot fishes (Naucrates?) were seen, and soon after a portion of an unusually large shark. Immediately a hook baited with salt pork was thrown overboard. When it touched the water these pilot fishes were seen to approach it, and then suddenly dart under the vessel. Soon a very large shark appeared and received the bait. As soon as safely secured the sailors drew him on deck. When a suitable opportunity was given for examining him, these two pilot fishes were seen attached to the body. At what particular portion they attached themselves I am unable to state. They were removed and placed in a bucket of salt water, where they swam about as if nothing had happened. — A. H. BURNELL.

A SPIDER FISHERMAN. — Just before the late war I was at Col. Oakley Bynum's spring, in Lawrence County, Ala., near the town of Courtland, where I saw a school of minnows playing in the sunshine near the edge of the water. All at once a spider as large as the end of my finger dropped down among them from a tree hanging over the spring. The spider seized one of the minnows near the head. The fish thus seized was about three inches long. As soon as it was seized by its captor it swam round swiftly in the water, and frequently dived to the bottom, yet the spider held on to it. Finally it came to the top, turned upon its back and died. It seemed to have been bitten or wounded on the back of the neck near where the head joins. When the fish was dead the spider moved off with it to the shore. The limb of the tree from which the spider must have fallen was between ten and fifteen feet above the water. Its success shows that it had the judgment of a practical engineer. — T. M. PETERS. (Communicated by the Smithsonian Institution.)

THE NATURE OF MONADS. — We have additional discoveries regarding the nature of monads by the Russian naturalist, Cienkowski. These organisms are on the border land of the plant world, and in some cases form protoplasmic nets (plasmodia) like the plant *Myxomycetes*. These plasmodia have the function of falling apart into amœba-like forms, which have hitherto been regarded as independent animal organisms; hence he thinks that many Amœbæ do not represent independent forms, but belong to the developmental cycle of other and plant-like organisms. Among the monads, Cienkowski, according to a German correspondent of *Nature*, has observed forms in various stages of encystment, self-division, and formation of colonies. But the most remarkable series of changes were observed in *Diplophrys stercorea*, an extremely small cell-like organism with a yellow spot and pseudopodia at two opposite ends of the body. These little bodies, observed in moist horse-dung, multiply by division, and form by union of the pseudopodia long strings in which separate individuals can glide to and fro. "Thus the boundary lines which it has so long been usual to draw between plant and animal organisms, and between the individual groups of those lowest forms of life, appear more and more illusory, and the supposition is recommended of a common lowest kingdom of organisms, that of Protista (Haeckel), out of which animals and plants have by degrees been differentiated."

MAYER'S ONTOGENY AND PHYLOGENY OF INSECTS.[1] — "Ontogeny" is a term devised by Haeckel, and means the development or embryonic and post-embryonic changes of the individual; "phylogeny" corresponds to its English equivalent, "ancestry," while the present essay is an attempt to explain the origin and ancestry of the six-footed insects (Hexapoda) from embryological and anatomical data. No new facts, so far as we are aware, are presented by the author, whose essay has, apparently, contrary to usage in German universities, been crowned not for the original work it contains but for the ideas suggested by the labors of preceding authors.

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[1] Ueber Ontogenie und Phylogenie der Insekten. Eine akademische Preisschrift. Von Dr. Paul Mayer, in Jena. Jenaische Zeitschrift für Naturwissenschaft. x. heft 2. Jena. 1876. With four plates, pp. 125–221.

In trying to reconstruct the form of the primitive insect, Mayer insists that it should be done from a study of the winged adult or *imago*, "since *a priori* we cannot know how far the form of the larva is original or secondary." Other authors have with better reasons derived the ancestral form from the larva.

Mayer's ancestral insect, then, which he calls *Protentomon*, had a body divided into a head, thorax, and abdomen, the latter consisting of eleven segments, while there were six thoracic feet with five-jointed tarsi, and two pairs of wings, nine (and perhaps eleven) pairs of stigmata, a pair of salivary glands, and four excretory organs or Malpighian vessels, besides a well-developed nervous system, heart, and an aaorta, as usual in existing insects.

This hypothetical *Protentomon* is derived by Mayer from the worms,[1] in opposition to the suggestions of Fritz Müller and Brauer that the insects originated from the Crustacea. This worm (1), the parent of the half a million species of insects which have peopled the globe during the present and past ages, was "an unjointed worm, a common st rting-point for the Tracheata and higher worms, and also a near relation of the ancestral form of the Crustacea." This worm then (2) transformed into a higher organism, with eighteen joints to its body and at least fourteen pairs of segmental organs, with perhaps also a masticatory apparatus in the form of jaws; and was perhaps nearly related to the existing Annelids. (3.) A third step towards the insects was a form similar to the second, but with ventral and perhaps also dorsal appendages on all the segments; it was still aquatic. It transformed (4) into a worm with tracheæ and with dissimilar segments (the appendages in part beginning to disappear). It lived in fresh water. and is called by our author *Prototracheas*. (5.) This *Prototracheas* became an *Archentomon*, still aquatic, with six feet, and clearly defined head, thorax, and abdomen. Finally this fifth form acquired two pairs of wings, was terrestrial in its habits, and became (6) a *Protentomon*.

The author then discusses the ancestry of the different orders of insects. It is noticeable that in treating of them he begins with the Hymenoptera and ends with the Neuroptera, following in fact, unconsciously, the reviewer's classification proposed in 1863. The Linnæan Neuroptera are, however, broken up into several orders, the author following the usual German system; but Mayer is the first German author, so far as we are aware, who places the Hymenoptera at the head of the insects, and the Coleoptera in the neighborhood of the Hemiptera and Orthoptera, where they unquestionably belong.

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[1] This view was advocated by the writer (though Mayer does not mention it) in Our Common Insects, chapter xiii., entitled Ancestry of Insects (1873). This is the more inexcusable since Dr. Mayer quotes from the essay.

Mayer adopts the suggestions of Bütschli and Semper that the air-tubes of insects originated from the segmental organs of worms, and, discarding Gegenbaur's view that the air-tubes were at first internal, closed air-sacs, he believes that the stigmata or breathing holes were the first to be formed. It may be objected that as insects are already provided with renal vessels, it is not necessary to suppose that segmental organs (also in part excretory) survived in them, and the inquiry arises whether the air-tubes of insects may not have arisen from the water-vascular system of the lower worms, which communicates with two or more external openings. In framing hypotheses like these, one guess may be as good as another.

The author, in a foot-note, combats with considerable unction our suggestion, made in 1867, that the head of insects consisted of seven segments. It may be observed that at that time we were influenced by the prevailing views of Agassiz, Dana, and others, who regarded the ocelli and eyes as homologues of the limbs. This view was corrected in the Memoirs of the Peabody Academy of Science, ii. 21, 1871 (a work from which our author quotes), and also in several other places, including the Guide to the Study of Insects, third edition, 1872; and the view that the normal number of cephalic segments is four was at the same time and in the same places insisted upon.

Dr. Mayer also quotes us as believing that the parts of the ovipositor are not homologous with the legs, a view we suggested in 1866, but after fresh embryological studies retracted in the above-mentioned Memoir in 1871 (which the author seems to have read), and also in other places, notably the essay on the Ancestry of Insects, quoted by Mayer, where the view that the ovipositor of the Hymenoptera, Hemiptera (Cicada), and Orthoptera, as well as the spring of the Thysanura and the spinnerets of spiders, are homologues of the legs is emphasized.

As regards the position of the primitive band of insects, Mayer ignores the remarks of Dr. Dohrn on its significance in classification, and considers that the circumstance whether the primitive band is external or floats within the yolk, is of much importance, laying down the law that "insects with an external primitive streak are in general older than those with an inner." We have previously[1] objected to Dohrn's classification of insects into "ectoblasts" and "entoblasts," and would make a similar objection to Mayer's views, since in weevils (*Attelabus*), abundantly proved by Dr. Le Conte to be the oldest of Coleoptera (a fact ignored by Dr. Mayer, whose genealogical tree of Coleoptera represents the antiquated classification of this order), we demonstrated that the primitive band is external, while in *Telephorus* it is internal, though our observations are called in question by Dr. Mayer, who, however, so far as we know, has never published any observations on the embryology of this or any other animal, the entire essay being based on facts observed by previous writers.

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[1] Embryological Studies on Hexapodous Insects. Memoirs of the Peabody Academy of Science, 1872, p. 15.

While the essay is interesting and suggestive, the leading idea that hexapodous insects first appeared as winged organisms and not as larval forms, will, we think, be found to have no valid foundation. We should with as much reason derive the acalephs from an ancestral free-swimming medusa, and not from a hydra-like form, or the Amphibia from the tailless rather than the tailed forms, views with which we imagine few zoölogists would agree. — A. S. PACKARD, JR.

ANTHROPOLOGY.

ABORIGINAL (?) GUN-FLINTS. — Among the ancient ruined buildings of Utah and Arizona I picked up two curious objects of stone, the use of which I for some time was unable to determine. At first I supposed them to have been arrow-points or scrapers which had been broken at the points, leaving the square buts, but on careful examination I found that they had each been laboriously chipped on the four edges, and from their general appearance had undoubtedly been used as gun-flints. In order to satisfy myself on this point, I procured a large number of modern flints made by the whites, and on comparison I found that the two from the West resembled them closely in size and shape, only differing in material and in the manner in which they had been flaked. They are from one eighth to one fourth of an inch in thickness, number one being thickest at the lower or striking edge and number two at the upper. The material of number one (by far the finer specimen) is a light gray flint with white and pink water markings. That of number two is a pink agate sprinkled with specks and blotches of red moss. Both of these varieties of stone are found throughout the West, and objects manufactured from them are numerous amongst the ruins. They are not to be found, except in rare cases, if at all, in the eastern portion of the United States, and we may therefore reasonably suppose that the flints were made on the Pacific slope. That such objects of a civilized people should occur among the rude implements of an aboriginal and prehistoric race is somewhat surprising, especially when it has heretofore been supposed that this particular section has not been traversed by whites until the past few years, when the flint-lock has been superseded by the percussion cap. This fact, however, cannot be vouched for, and although we know that no official expeditions have passed over this country, it is possible that hunters or wandering scouts may have visited the ruins of the San Juan Valley. The district in which I found the flints has not been occupied by tribes of Indians for many years, as it is a barren, dry desert, devoid of water (with the exception of the warm San Juan) and almost destitute of grass and wood. It is, indeed, a matter of doubt whether it has been inhabited since the disappearance of the Pueblo race which built and occupied the old houses which have been lying in ruins for centuries. The fact that these objects were discovered among arrow-heads, pottery, and implements of undoubted antiquity, associated with no objects of modern date, would point to an ancient origin. The flint-lock, however, did not come into use until the middle of the seventeenth century, having originated in France about the year 1635. They could not, therefore, have been dropped by the Spaniards, who traveled through Arizona and New Mexico in the early part of the *sixteenth* century. The match-lock was employed by them in their conquests through Mexico and the north, even after the wheel-lock had been invented in Italy.

The two specimens possess all the appearance of having been fashioned by the aborigines in their peculiar manner. It is not impossible that they may have been made by Indians under the direction of European hunters or explorers, and, on the other hand, they may have been manufactured by whites. The nomadic tribes of the Southwest must have procured arms from the adventurous pioneers as early as the middle of the eighteenth century, and flints must necessarily have been made by the savages as the first ones were lost or broken. Since the flint-lock has been out of use for many years, it is highly probable that the two objects herein described were dropped where they were found, as early as the latter part of the last century or during the first few years of this. They are particularly interesting, however, as showing that the valley of the San Juan River has in all probability been traversed by whites, possibly a century or more ago. It is also possible that the flints may have been brought to that section by Indians from a distant locality; but the first supposition seems to me the most reasonable. — EDWIN A. BARBER.

ANTHROPOLOGICAL NEWS. — Twenty-eight pages of Nos. 1 and 2 of the *Mittheilungen der anthropologischen Gesellschaft in Wien* are taken up with a discussion by Ferd. Freiherrn von Adrian upon the influence of vertical position on the earth's surface upon human settlements. The article is rendered exceedingly valuable by abundant bibliographical references. In *Revue Scientifique* for July 15th, M. Paul Bert handles a kindred topic in a contribution entitled "La Pression de l'Air et les Êtres vivants. In the same number of the review, Turkish manners in 1650 are discussed by a "traveler from Algeria."

Some light is thrown upon prehistoric batons, so called, by a pamphlet published in Lyons by M. F. Chabas, and entitled Sur l'Usage des Bâtons de Main chez les Hébreux et dans l'ancienne Égypte. One of the best features in the treatise is the collation of authorities.

M. Émile Guimet has edited in the same form from the Lyons press a tract by M. Chabas upon the time of the Exodus. From numerous parallelisms between the Jewish Scriptures and the papyri the learned author concludes to place the Exodus in the reign of Menephta I., the successor of Rameses II., of the XIXth dynasty. The paper was first read before the Academy of Science, Belles-Lettres, and Art of Lyons, April 27, 1875.

The contents of Nos. 6 and 7 of *Matériaux* are very nicely distributed over the countries of Europe in which archæological investigations are in progress. Vladimir de Mainoff contributes an article upon the Kourganes (tumuli) of Little Russia. These structures are the burial-mounds of the Severianes, in the transition period between the bronze and the iron age. Some of them contain burials by inhumation, others by incineration. In each of the two kinds of Kourganes there is a gradation of the form of interment.

Scandinavia has an unusual share of space devoted to the following themes: the State Museum of History, the history of Swedish archæological researches; the age of bronze in Northern Sweden; the antiquities of Bohuslaen, and, finally, three very instructive sketches upon Finnish antiquities and history.

With reference to France, we have a continuation of the discussion between Abbé Maillard and M. Mortillet upon the stratigraphical relation between the Solutrian and the Moustierian Age, an account of prehistoric monuments in different districts of France, and a very valuable table of the number of stations, grottoes, and dolmens in each of the departments.

The review of Italy embraces papers relative to archæological matters purely. The only article relative to extra-European matters is an account of a prehistoric atelier at Hassi-el M' Kaddem, eight kilometres from the oases of Ouargla. Among the articles discovered were arrowheads, beads, and pottery.

Richard Andree contributes to the Austrian *Mittheilungen* for February, 1876, an article upon lucky days, lucky meetings, and augury in the history of culture.

We have in the first quarterly part of the *Archiv für Anthropologie* the usual array of valuable matter. Dr. Schmidt, of Essen, gives us a paper upon the leveling of the skull. After examining the various plans and instruments which have been devised, the author concludes that the level which brings the beginning of the zygomatic arches over the opening of the ear in a line with the lower edge of the orbital cavity, adopted at a general meeting of the Göttingen society, is the best horizontal, coming the nearest to the true physiological horizontal, and having, of all the normals, the greatest stability. Professor A. Eclar contributes an article upon the influence of cranial deformation on the volume, position, and shape of the brain and of its separate parts. The name of this author is sufficient to render his work authoritative upon this vexed question. Professor Japetus Steenstrup reviews the question, "Have we found in the interglacial strata of Switzerland veritable traces of human beings or only the work of beavers?" Wood-cuts of sticks gnawed by modern rodents for food and for use are given. Shorter articles occur upon the quaternary fauna in the valley of the Donau, upon prehistoric and culture-historical terminology, upon the natives of

New Guinea and the neighboring islands, upon the Wetzikon sticks, and upon recent anthropological works which have appeared.

Professor Paolo Mantegazza contributes to *Archivio* a sixteen-page article upon the expressions of grief.

The subsection of anthropology was organized by the American Association at Buffalo, with Lewis H. Morgan as chairman and Otis T. Mason as secretary. Professor Morse, in his address before Section B, alluded to the eminent labors of Morton, Wyman, and others in special fields, and the list might be multiplied by adding the names of many living and dead, who, in America, have added materially to the progress of anthropology. The aim of the subsection of the American Association is to bring the authors of these researches together, and to make them better acquainted. It is earnestly hoped that the meeting to be held next year at Nashville will be crowded with anthropologists, specialists in the various fields of descriptive and deductive anthropology of extinct and extant races, in every part of its three divisions, of man, environment, and culture. — O. T. MASON.

GEOLOGY AND PALÆONTOLOGY.

PALÆONTOLOGY AND THE DOCTRINE OF DESCENT. — In an essay on the Pliocene fresh-water shells of Southern Austria, by Dr. Neumayr and Herr Paul, the authors describe numerous modifications of the genus *Vivipara* or *Paludina*, which occur in prodigious abundance throughout the whole series of fresh-water strata. Of this genus there are forty distinct *forms* (Dr. Neumayr very properly hesitates to call them all *species*) which are named and described in this monograph, and between which, as the authors show, so many connecting links, clearly illustrating the mode of derivation of the newer from the older types, have been detected. The authors, remarks Mr. J. W. Judd in *Nature*, have demonstrated that the species with highly complicated ornamentation were variously derived by descent — the lines of which are in most cases perfectly clear and obvious — from the simple and unornamented *Vivipara achatinoides* of the Congerien-schichten, which underlies the Paludina beds. Some of these forms have been regarded as types of a distinct genus (*Tulotoma*) by Sanberger. "And hence we are led to the conclusion that a vast number of forms, certainly exhibiting specific distinctions, and, according to some naturalists, differences even entitled to be regarded as of generic value, have all a common ancestry."

ICE-MARKS IN NEWFOUNDLAND. — In the second part of his article on Ice and Ice Work in Newfoundland, in the *Geological Magazine*, Professor J. Milne says that "the island itself, its principal bays, its mountains, its lakes and rivers, its lines of igneous protrusions, its ice-grooves and scratches, and the general strike of the rocks, which, as was shown by Jukes, may in part account for the tendencies of the other features, have all been shown to trend from about 27° east of north to

27° west of south." He believes that the ice-marks were made by glaciers rather than by floating ice (though there are still a few lingering supporters of the iceberg theory), thus substantiating, by the results of two summers' travels in Newfoundland, the observations made by the undersigned during two summers' travels along the coast of Labrador. — A. S. Packard, Jr.

GEOGRAPHY AND EXPLORATION.

Extracts from Stanley's Last Letters from Central Africa. — From one of the many spurs of Kabuga we obtained a passing glimpse of the king of mountains, Gambaragara, which attains an altitude of between thirteen thousand and fifteen thousand feet above the ocean. Snow is frequently seen, though not perpetual. On its summits dwell the chief medicine men of Kabba Rega, a people of European complexion.

Some half-dozen of these people I have seen, and at sight of them I was reminded of what Mukamba, king of Uzige, told Livingstone and myself respecting white people who live far north of his country. They are a handsome race, and some of the women are singularly beautiful. Their hair is kinky, but inclined to brown in color. Their features are regular, lips thin, but their noses, though well-shaped, are somewhat thick at the point. Several of their descendants are scattered throughout Unyoro, Ankori, and Ruanda, and the royal family of the latter powerful country are distinguished, I am told, by their pale complexions. The queen of Sasua Islands, in the Victoria Nyanza, is a descendant of this tribe.

Whence came this singular people I have had no means of ascertaining except from the Waganda, who say that the first king of Unyoro gave them the land around the base of Gambaragara Mountain, wherein through many vicissitudes they have continued to reside for centuries. On the approach of an invading host they retreat to the summit of the mountain, the intense cold of which defies the most determined of their enemies.

The geographical knowledge we have been able to acquire by our forcible push to the Albert Nyanza is considerable. The lay of the plateau separating the great reservoirs of the Nile, the Victoria and Albert Nyanzas, the structure of the mountains and ridges, and the course of the water-sheds, and the course of the rivers Katonga and Rusango have been revealed. The great mountain Gambaragara and its singular people have been discovered, besides a portion of a gulf of the Albert, which I have taken the liberty to call, in honor of her Royal Highness Princess Beatrice, Beatrice Gulf.

This gulf, almost a lake by itself, is formed by the promontory of Usongora, which runs southwest some thirty miles from a point ten geographical miles north of Unyampaka. The eastern coast of the gulf is formed by the countries of Irangara, Unyampaka, Buhuju, and Mpororo, which coast line runs a nearly south-southwest course. Between Mpororo and Usongora extend the islands of the maritime state of Utumbi. West of Usongora is Ukonju, on the western coast of Lake Albert, reputed to be peopled by cannibals. North of Ukonju is the great country of Ulegga.

Coming to the eastern coast of Lake Albert we have Ruanda running from Mpororo on the east to Ukonju on the west, occupying the whole of the south and southeast coast of Lake Albert. North of Unyampaka, on the east side, is Irangara, and north of Irangara the district of Toro. Unyoro occupies the whole of the east side from the Murchison Falls of the Victoria Nile to Mpororo, for Unyampaka, Toro, Buhuju, and Irangara are merely districts of Unyoro. The great promontory of Usongora, which half shuts in Beatrice Gulf, is tributary to Kabba Rega, though governed by Nyika, king of Gambaragara.

Usongora is the great salt field whence all the surrounding countries obtain their salt. It is, from all accounts, a very land of wonders, but the traveler desirous of exploring it should have a thousand Sniders to protect him, for the natives, like those of Ankori, care for nothing but milk and goatskins. Among the wonders credited to it are a mountain emitting "fire and stones," a salt lake of considerable extent, several hills of rock salt, a large plain encrusted thickly with salt and alkali, a breed of very large dogs of extraordinary ferocity, and a race of such long-legged natives that ordinary mortals regard them with surprise and awe.

After circumnavigating Lake Windermere we entered the Kagera River, and almost immediately it flashed on my mind that I had made another grand discovery, — that I had discovered, in fact, the true parent of the Victoria Nile.

If you glance at Speke's map you will perceive that he calls this river the Kitangule River, and that he has two tributaries running to it called respectively the Luchuro and the Ingezi. Speke, so wonderfully correct, with a mind which grasped geographical knowledge with great acuteness and arranged the details with clever precision and accuracy, is seriously in error in calling this noble river Kitangule. Neither Waganda nor Wanyamba know it by that name, but they all know the Kagera River, which flows near Kitangule. From its mouth to Urundi it is known by the natives on both banks as the Kagera River. The Luchuro, or rather Lukaro, means "higher up," but is no name of any river. Of the Ingezi I shall have occasion to speak further on.

While exploring the Victoria Lake I ascended a few miles up the Kagera, and was then struck with its great volume and depth, so much so as to rank it as the principal affluent of the Victoria Lake. But in coming south, and crossing it at Kitangule, I sounded it and found fourteen fathoms of water, or eighty-four feet deep, and one hundred and twenty yards wide. This fact, added to the determined opinion of the natives that the Kagera was an arm of the Albert Nyanza, caused me to think the river worth exploring. I knew, as all know who know anything of African geography, that the Kagera could not be an effluent of Lake Albert, but their repeated statements to that effect caused me to suspect that such a great body of water could not be created by the drainage of Ruanda and Karagwe; that it ought to have its source much farther, or from some lake situate between lakes Albert and Tanganyika.

When I explored Lake Windermere I discovered, by sounding, that it had an average depth of forty feet, and that it was fed and drained by the Kagera. On entering the Kagera I stated that it flashed on my mind that the Kagera was the real parent of the Victoria Nile; by sounding I found fifty-two feet of water in a river fifty yards wide. I proceeded on my voyage three days up the river, and came to another lake about nine miles long and a mile in width, situate on the right hand of the stream. At the southern end of the lake, and after working our way through two miles of papyrus, we came to the island of Unyamubi, a mile and a half in length.

Ascending the highest point on the island the secret of the Ingezi or Kagera was revealed. Standing in the middle of the island I perceived it was about three miles from the coast of Karagwe and three miles from the coast of Kishakka, west, so that the width of the Ingezi at this point was about six miles, and north it stretched away broader, and beyond the horizon green papyri mixed with broad gray gleams of water. I discovered, after further exploration, that the expanses of papyri floated over a depth of from nine to fourteen feet of water; that the papyri, in fact, covered a large portion of a long, shallow lake; that the river, though apparently a mere swift-flowing body of water, confined apparently within proper banks by dense, tall fields of papyri, was a mere current, and that underneath the papyri it supplied a lake, varying from five to fourteen miles in width and about eighty geographical miles in length.

Descending the Kagera again, some five miles from Unyamubi the boat entered a large lake on the left side, which, when explored, proved to be thirteen geographical miles in length by eight in breadth.

From its extreme western side to the mainland of Karagwe east was fourteen miles, eight of which was clear, open water; the other six were covered by floating fields of papyri, large masses or islands of which drift to and fro daily. By following this lake to its southern extremity I penetrated between Ruanda and Kishakka. I attempted to land in Ruanda, but was driven back to the boat by war-cries, which the natives sounded shrill and loud.

Throughout the entire length (eighty miles) the Kagera maintains almost the same volume and almost the same width, discharging its surplus waters to the right and to the left as it flows on, feeding, by means of the underground channels, what might be called by an observer on land seventeen separate lakes, but which are in reality one lake, connected together underneath the fields of papyri, and by lagoon-like channels meandering tortuously enough between detached fields of the most prolific reed. The open expanses of water are called by the natives so many "rwerus" or lakes; the lagoons connecting them and the reed-covered water are known by the name of "Ingezi." What Speke has styled Lake Windermere is one of these rwerus, and is nine miles in extreme length and from one to three miles in width. By boiling point I ascertained it to be at an altitude of 3760 feet above the ocean and about 320 feet above Lake Victoria. The extreme north point of this singular lake is north by east from Uhimba south, its extreme southern point. Karagwe occupies the whole of its eastern side. Southwest it is bounded by Kishakka, west by Muvari, in Ruanda, northwest by Mpororo, and northeast by Ankori. At the point where Ankori faces Karagwe, the lake contracts, becomes a tumultuous, noisy river, creates whirlpools, and dashes itself madly into foam and spray against opposing rocks, and finally rolls over a wall of rock ten or twelve feet deep with a tremendous uproar, for which the natives call it Morongo, or the Noisy Falls.

Since I left Zanzibar I have traveled 720 miles by land and 1004 miles (by computation) by water. This in six months is good work. Over one hundred positions settled by astronomical observations, for you must know that from the very day I got my commission I strenuously prepared to fit myself for geographical work, in order that I might be able to complete Speke, Burton, Baker, and Livingstone's labors, which they left undone. Now Speke's work is done. What he commenced I have finished. I do not know whether you comprehend the drift of this expedition, but I will explain.

You must know that Speke, in 1858, came to the southwest end of Lake Victoria, and from a hill near the lake he discovered the vast body of fresh water. Having gazed his fill he returned to England and was commissioned to find its outlet. In 1861 and 1862 he marched from Zanzibar to Ugawa, when he saw the lake again. At the Ripon Falls he saw the lake discharge itself into the Victoria Nile, and went home again, imagining that he had done his work. If his work was merely to find the outlet of Lake Victoria he completed his task, but if his task was to discover the sources of the Nile he had but begun his work. He went away without discovering the feeders of Lake Victoria, which in reality are the Nile's sources; extreme southern sources, I mean. Then Baker came to Central Africa and discovered Lake Albert. He voyaged sixty miles on the lake, and he ran home also without knowing anything of the lake's sources. Burton went to Taraganika, saw it, and returned home without knowing its extent, outlet, or affluents. Livingstone came next to the chain of lakes west of Taraganika, and died nobly in harness. Well, we are sent to complete what these several travelers have begun. While they are content with having discovered lakes, I must be content with exploring these lakes and discovering their sources, and unraveling the complications of geographers at home. It is a mighty work, but a fourth of that work is already done.

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SCIENTIFIC NEWS.

— The Eucalyptus or Australian gum-tree continues to be largely planted in California not only for ornamental but also for economic purposes. A large forest of these trees has been planted by a company and is situated on the line of railroad between Los Angeles and Anaheim. A recent statement of the company's affairs shows that it owns two hundred acres of fine land, on which are houses and other improvements. About one hundred and forty acres have been set out in Eucalyptus, containing about eighty thousand trees. Of these some thirty thousand are from nine to fifteen feet high. The total cost up to January 1st, including purchase of land, houses, teams, etc., is $12,523. The estimated expense for the first year, prior to incorporating the company, was $12,750, the actual expense being less than the estimate. The present value of the property is from $40,000 to $60,000, and this at a total cost of $12,523. The remaining sixty acres will be set out by the 5th of May, after which time the expenses will be but little. At the start the estimated total cost for four years was $1,000 to $20,000 or 20 per cent. of the capital, which will be reduced, according to later estimates, to $16,000 or $18,000, and it is believed that at the end of four years the property will be worth not less than $100,000. Only a few shares have changed hands during the year, and these at an advance equal to three per cent. The plantation is owned by seventeen persons. The young trees (*Eucalyptus*) have been produced in greater numbers in California the past season than ever before, and are sold by the nurserymen at much lower prices than previously, with an increasing demand.

— An essay by Dr. C. F. Lütken on the fresh-water fishes of Brazil, including some interesting new genera and species, and illustrated with a number of exquisite plates and numerous fine wood-cuts, appears in the memoirs of the Royal Academy of Copenhagen. The work is based on collections made some years ago by Professor J. Reinhardt. The memoir will prove of a good deal of interest to American ichthyologists.

— The veteran microscopist and naturalist, C. G. Ehrenberg, died in July last, aged eighty-two. His intellectual activity remained undiminished almost to the last, and though he failed to interpret aright the structure of the Infusoria, his zoölogical and micro-geological works were still valuable and original.

— Messrs. Macmillan & Co. announce as to be published in October

"The Atlantic. An Account of the General Results of the Exploring Expedition of H. M. S. Challenger." By Sir Wyville Thompson, F. R. S., LL. D., Director of the Scientific Staff of the Expedition. Two other volumes containing the Voyages of the Challenger in the Pacific and South seas will follow.

— Prof. C. F. Hartt, chief of the Imperial Geological Survey of Brazil, was at last accounts about sending a party to make a thorough exploration of the Amazonian region in order to connect the work with his more southerly investigations. Mr. O. A. Derby will be a prominent member of this northern division of the survey. At last accounts Professor Hartt was engaged in a careful study of the interior of Brazil.

— In the course of a pleasant speech by Professor Huxley on being introduced to the American Association for the Advancement of Science, he said, "It is popularly said abroad that you have no antiquities in America. If you talk about the trumpery of three or four thousand years of history, it is true. But, in the large sense, as referring to times before man made his momentary appearance, America is the place to study the antiquities of the globe. The reality of the enormous amount of material here has far surpassed my anticipation. I have studied the collection gathered by Professor Marsh, at New Haven. There is none like it in Europe, not only in extent of time covered, but by reason of its bearing on the problem of evolution. Whereas, before this collection was made, evolution was a matter of speculative reasoning, it is now a matter of fact and history, as much as the monuments of Egypt. In that collection are the facts of the succession of forms and the history of their evolution. All that now remains to be asked is how; and that is a subordinate question."

— Mr. A. H. Curtiss, who was employed by the Agricultural Department to collect specimens of the trees of the Southern States for the Centennial Exposition, proposes to commence a systematic distribution of Southern plants, and hopes to receive sufficient aid from herbalists to enable him to travel for a number of years for the purpose of making the sets as complete as possible. Commencing with large collections made in Florida, Georgia, South Carolina, and other States, he intends to issue three hundred species each winter, keeping an exact record of all specimens sent out, so that those lacking fruit, flowers, etc., may be completed in future years (without extra charge). The price per set of three hundred species will be $25, charges for transportation prepaid by mail or by express to New York. Address A. H. Curtiss, Jacksonville, Florida.

— Mr. Edward Newman, of London, the well-known entomologist, died June 12th at the age of seventy-five. He was editor, at the time of his death, of the *Zoölogist* and *Entomologist*, and the author of several popular works on British butterflies and moths.

— A resolution has been introduced into Congress, according to *Har-*

per's Weekly, directing the Secretary of State to cause to be published a brief history of the several surveys and expeditions ordered and prosecuted by the United States during the century just closed, including those under the direction of the War, Navy, and Interior Departments, and other bureaus. An appropriation of $10,000 is suggested for the purpose of carrying this into effect.

— Baron von Nolcken has just returned to Germany from Columbia with ten thousand macrolepidoptera collected by him in that country, besides many of the smaller moths.

— At a meeting of the Paris Geographical Society held August 2d, Lieutenant Wyse announced to the society that the government of Columbia had granted to a company, represented by General Türr, the privilege of constructing a ship-canal through the Isthmus of Darien. A body of surveyors would leave in November, in order to make the final surveys, and he trusted the enterprise would meet with the support of the international committee recently formed under the presidency of M. de Lesseps. M. Leon Drouillet announced that he was about to proceed to America, and would use his best efforts to establish there a sub-committee for the scientific exploration of the American isthmus. Their committee intended to study this question without prejudice, for, in spite of this new concession, our information was as yet very far from being complete.

M. Hayaux du Tilly read a paper on the ivory trade. England alone imported annually 1,200,000 pounds of ivory, and to obtain this quantity it was necessary to kill annually 30,000 elephants, and the ivory supply of the whole world probably caused the destruction of 100,000 elephants annually, and, as females and males were killed indiscriminately, this animal would soon become extinct.

— During the meetings of the American Public Health Association held in Boston, October 2d–6th, Mr. James T. Gardner read a paper on the relations of Topographical Surveys and Maps to Public Health. Some relations of general climatic conditions to the health of man have long been recognized; modern investigations have shown that local causes are as active and effective in producing disease, though more subtle and obscure in their operation.

Those natural local conditions most seriously affecting health are the conformation of the earth's surface and its underlying structure, yet, though this is supported by ample evidence, the exact effects produced are little understood, from lack of facts upon which to base conclusions. To determine the laws of action of the surface structure upon health, detailed and exact records of topography and geology over large areas, and public health records of the regions, are absolutely necessary.

The former class of facts must be ascertained by careful topographical and geological surveys, and registered in maps, which ought to be followed by an equally accurate sanitary survey, based upon these maps and constantly referred to them. In this manner only the laws of the earth's surface-influence and action upon health will be derived from the philosophical and practical study of facts.

The paper was discussed by Professor Pickering, who referred particularly to the hay fever, and the immunity therefrom of several villages in New Hampshire. The income brought to the state from this very fact, he believed, would pay the cost of a state survey.

Dr. T. Sterry Hunt also spoke on the same subject. He alluded to the advantages of surveys by boring to such a depth as to ascertain the exact character of the underlying soil, and thus to learn the conditions of underground drainage. In many cases where this had been done it had been found that there were often, where it was to be least expected, large basins in the underlying floor of the soil, in which stagnant waters collected.

President Runkle thought that the greatest objection made by legislatures was apt to be the expense of making them ; yet he believed that the expenses of the best topographical surveys would all be paid by entirely new industries, which they would create.

The subject was further discussed by Dr. J. S. Billings, U. S. A., and Professor J. D. Whitney, of Cambridge.

Dr. Harris, in behalf of the committee on the proposed sanitary survey of the United States, reported the following resolution : —

Resolved, That it is the opinion of the American Public Health Association that in every State, especially the more populous ones, a thoroughly accurate topographical survey is so essentially necessary as a basis of sanitary surveys and systematic drainage, and also the most desirable hygienic researches and works for prevention of disease, that the execution of such state surveys is a duty which should be undertaken by the States as a duty to the life and welfare of the people.

The resolution was adopted.

— The Zoölogical and Botanical Society of Vienna not only commemorated its twenty-fifth anniversary by a festival, but erected an intellectual monument of the event in the form of a fine quarto volume of monographs on various zoölogical and botanical subjects, contributed by its leading members. The volume is well printed and illustrated with twenty plates. Of the more noticeable zoological memoirs is one on the morphology of the segments of the body of Orthoptera, by C. Brunner von Wattenwyl. A. von Pelzeln contributes an essay, illustrated by a map, on the geographical distribution of the mammals of the Malay Peninsula, while the lizards and snakes of the Galapagos Islands are described by Dr. Steindachner, the seven plates having been drawn by Konopicki, whose exquisite work is well known to American zoölogists. The large Iguana-like lizards (*Amblyrhynchus cristatus* and *Conolophus subcristatus*) characterizing these islands are beautifully figured.

PROCEEDINGS OF SOCIETIES.

Appalachian Mountain Club. — July 26th. At a field-meeting held in North Conway, Prof. Charles E. Fay, of Tufts College, in behalf of Professor E. T. Quimby, of the Coast Survey, and a member of the Mountain Club, spoke of recent coast survey work among the mountains.

Mr. Wm. G. Nowell, of the English High School, Boston, interested the meeting with an account of explorations on Mount Adams and the opening of a new path, displaying the club stamp (A) adopted for making blazes on trees, and the club stencil (A. M. C.) for identifying signals on rocky summits.

Mr. J. Rayner Edmands, engineer, Boston, exhibited profile views of the mountains obtained with the help of a camera he had ingeniously devised. He also showed an improved form of knapsack for Appalachian travel.

Mr. G. C. Mann, of Cambridge, showed a contour map of the United States that he had colored with much skill, and thereby illustrated the height of mountains, improving on the usual style of such illustration. He enlarged on his theme with much minuteness and patience of detail.

Professor Hitchcock, of Dartmouth College, and State Geologist of New Hampshire, unrolled various geological charts and explained the geological structure of the New Hampshire mountains.

Professor Pickering, the president, gave an account of his own work in determining the height of various mountain points, and then pleasantly referred to the controversy prevailing with regard to the name of the mountain near at hand, whether Pequawket, Kiarsarge, or Kearsarge. He said that the club greatly desired to ascertain and recognize the true name of the mountain, but not to invent a new one and affix it on their own responsibility, and Rev. Mr. Worcester submitted resolutions covering this point, to allay any misapprehension. In these resolutions, which were adopted, a desire was also expressed to pay proper regard to the local preferences in any community as to the names of mountains.

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SCIENTIFIC SERIALS.[1]

American Journal of Science and Arts. — October. On Cephalization, by J. D. Dana. Part V. Cephalization a Fundamental Principle in the Development of the System of Animal Life. Geological Chart of the United States east of the Rocky Mountains and of Canada by F. H. Bradley.

Annales des Sciences naturelles. — July 15th. Recherches sur les Réseaux vasculaires de la Chambre postérieure de l'Œil des Vertébrates, par H. Beauregard.

Monthly Microscopical Journal. — September. A New Process of Preparing and Staining Fresh Brain for Microscopic Examination, by B. Lewis. The Potato Fungus; Germination of the Resting Spores, by W. G. Smith. The Application of Photography to Micrometry, with Special Reference to the Micrometry of Blood in Criminal Cases, by J. J. Woodward.

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[1] The articles enumerated under this head will be for the most part selected.

THE GEOLOGICAL MAGAZINE. — September. The Climate Controversy, by S. V. Wood, Jr. On a New [Cretaceous] Hexactinellid Sponge, by W. J. Sollas. Ice and Ice-Work in Newfoundland, by J. Milne. On Fossil Fish in North Devon, by T. M. Hall.

THE GEOGRAPHICAL MAGAZINE. — September. Census of the British Isles, 1871. Birthplaces and Migration, by E. G. Ravenstein. Sketches of Life in Greenland, by S. N. R. Along the Turkish Border, by D. Ker. The Statistical Survey of India. Stanley's Proceedings in the Lake Region of Central Africa. The Sea Level, by H. P. Malet.

PETERMANN'S GEOGRAPHISCHER MITTHEILUNGEN. — June 30th. Die Wirkungen der Winde auf die Gestaltung der Erde; von F. Czerny, July 18th. Die Vorgänge in der Türkei in ihrer ethnographischen und geschichtlichen Begründung, von F. V. Stein. Die geographische Festlegung des Mündungsgebietes der Ób und Jenessei durch Nordenskjöld's Expedition, 1875; mit Karte. Largeau's zweite Expedition nach Rhadames und einige Worte über Algerien, von G. Rohlfs. Reise von Dr. Güssfeldt und Dr. Schweinfurth durch die arabische Wüste vom Nil zum Rothen Meere, 1876, von G. Schweinfurth. Prof. Dr. P. Ascherson's Reise nach der kleinen Oase, 1876, von G. Schweinfurth. Der Abschluss der Nilquellen-Frage, von E. Behm. August 15th. Barometrische Höhenbestimmungen in Columbien, von E. Steinheil. Resultate der meteorol. Beobachtungen auf Spitzbergen und in Ost-Grönland. Nach Wijkander und Koldervey. Beitrag zur Kenntniss der Windverhältnisse in den Spitzbergen umgebenden Theilen des Eismeeres, von Dr. A. Wijkander.

ARCHIVES DE ZOÖLOGIE EXPÉRIMENTALE ET GÉNÉRALE 1876. — No. 1. Études sur le Développement des Mollusques, par H. Fol.

ANNALS AND MAGAZINE OF NATURAL HISTORY. — August. Notes on the Palæozoic Corals of the State of Ohio, by H. A. Nicholson. September. The Development of the Ova of Chthonius in the Body of the Mother, and the Formation of the Blastoderm, by A. Stecker. Descriptions and Figures of Deep-Sea Sponges and their Spicules, from the Atlantic Ocean, dredged up on Board H. M. S. Porcupine, chiefly in 1869, by H. J. Carter. On some New and Remarkable North-Atlantic Brachiopoda, by J. G. Jeffreys. On the Structure of the Mouth in Sucking Crustacea, by J. C. Schiödte.

THE

AMERICAN NATURALIST.

Vol. x — DECEMBER, 1876. — No. 12.

THE DEVELOPMENT OF FLOUNDERS.

BY ALEXANDER AGASSIZ.

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THE manner in which the eyes of a flounder become placed on one side of the body has formed a fertile subject for theories. I do not at present propose to discuss the explanations given to account for the facts, but merely to state the results of observations made while studying the development of a number of species of flounders common to our coasts. In the case of five species the passage of the eye from one side to the other is not, as urged by Malm, a simple tendency of the eye of the "blind side" (the side upon which the flounder lies) to turn towards the light and thus carry the surrounding parts of the head with it. The eye placed on the blind side actually travels from its original place (symmetrical with the eye of the opposite side) frontwards and upwards on the blind side, resorbing the tissues in its way, new tissues forming behind; there follows this movement of translation a certain amount of torsion of the whole of the frontal part of the head, which commences only after the eye of the blind side has nearly reached the upper edge of that side, quite a distance in advance of its primitive position. This torsion of course takes place most readily, occurring as it does during a stage when the whole bony fabric of the skull is still cartilaginous, and it is the torsion which ends in bringing the eye to the opposite side. In four of these species of flounders the dorsal fin did not at that young stage extend to the posterior edge of the orbit of the eye coming from the blind side.

In another species, after the eye had thus by the same process of translation and of torsion been brought from the one side to the other, the dorsal fin gradually extended beyond the anterior edge of the orbit of this eye. This young flounder thus soon presented a stage in which the eye from the blind side appeared

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to have passed through the head between the frontal bone and the base of the anterior rays of the dorsal fin. As I had, however, followed the whole development in living specimens, I knew from actual observation that the mode of transfer of the right eye had been identical with that of the preceding species. These observations thus far confirm in the main Malm's explanation of the development of young symmetrical flounders into the well-known older stages. To my great astonishment, therefore, I captured one day a number of flounders (about an inch in length) closely allied to the *Plagusiæ* of Steenstrup, the so-called *Bascania* of Schiödte; they were so perfectly transparent that they seemed the merest film on the bottom of the glass vessel in which they were kept. They were still entirely symmetrical, the eyes well removed from the snout, with a dorsal fin extending almost to the nostril, far in advance of the anterior edge of the orbits of the eyes. They were of course at once set down (from their size) as belonging to a species of flounder in which the eyes probably remained always symmetrical, and I prepared to watch its future development. It was therefore with considerable interest that I noticed, after a few days, that one eye, the right, moved its place somewhat towards the upper part of the body, so that when the young fish was laid on its side, the upper half of the right eye could be plainly seen, through the perfectly transparent body, to project above the left eye. The right eye (as is the case with the eyes of all flounders), being capable of very extensive vertical movements, through an arc of nearly 180°, could thus readily turn to look through the body, above the left eye, and see what was passing on the left side, the right eye being of course useless on its own side as long as the fish lay on its side. I may mention here that this young flounder, until long after the right eye came out on the left side, continued frequently to swim vertically, and that for a considerable length of time. This slight upward tendency of the right eye was continued in connection with a motion of translation towards the anterior part of the head till the eye, when seen through the body from the left side, was entirely clear of the left eye, and was thus placed somewhat in advance and above it, but still entirely in the rear of the base of the dorsal fin extending to the end of the snout. What was my astonishment on the following day, on turning over the young flounder on its left side, to find that the right eye had actually sunk into the tissues of the head, penetrating into the space between the base of the dorsal fin and the frontal bone, to such an extent that the tissues adjoining the orbit had slowly closed over a part of the eye, leaving only a small elliptical opening, smaller than the pupil, through which the right eye could look when the fish was swimming vertically. While the young flounder lay on its side, the right eye was constantly used in looking through the body, and could evidently see extremely well all that took place on the left side. On the following day the eye had pushed its way still farther through, so that a small opening now appeared opposite it, on the left side, through which the right eye could now see directly, the original opening on the right side being almost entirely closed. Soon after, this new opening on the left increased gradually in size, the right eye pushing its way more and more to the surface and finally looking outward on the left side with as much freedom as the eye originally on the left; the opening of the right side having permanently closed. I have thus in one and the same specimen been able to follow the passage of the eye from the right side to the left through the integuments of the head, between the base of the dorsal fin and the frontal bone.

This observation leads to somewhat different conclusions from those of Steenstrup, who thought he could prove (from an examination of alcoholic specimens) that the eye from the right side passed under the frontal bone. This is evidently not the case here, the eye passing round it, there being only a very slight torsion of the frontal in this young stage. Although at first glance this appears so radically a different method of transfer of the eye from the one described above, yet if the dorsal fin had not extended beyond the posterior edge of the right orbit the process would have been the same, as is readily seen. I hope soon to give full details, with illustrations, of the process of transfer of the eye in its different stages, in a paper I am preparing on the young stages of a few of our bony marine fishes.

But while I have thus been able to trace step by step in living specimens the transfer of the eye from one side to the other, I can give no explanation of the cause which compels flounders to lie on their side. The explanations usually given are not satisfactory. For the great depth of the body, the position of the dorsal and of the ventral fins, the undulating mode of swimming, — all these are so many causes specially adapted to enable them to swim in a vertical position. In fact, they always swim vertically in young stages, when their capacity for vertical support is infinitely less than when they commence to lie on one side.

The rapidity with which the young flounders adapt themselves to the color of the ground upon which they are placed is marvelous. In one of the species the red, yellow, and black pigment cells were brought into the proper combination and prominence with such rapidity that it seemed hardly credible that the same fish could assume such different hues in so short a time. The size and number of these pigment cells, however, readily account for all this.

The young of this transparent flounder do not invariably lie down on the right side; it seems almost a matter of chance which side they choose. Out of fifteen specimens eight lay down on the left and all died without being able to accomplish any part of the transfer of the left eye to the right side, although they lived quite long enough for the other seven, which turned down on the right side, to accomplish the transfer, or nearly so. This incapacity may account for the rarity of sinistral forms of flounders, and *vice versa*. In the other species mentioned above, all the young I have had occasion to keep alive turned down on the proper side for a successful transfer of the eye. I may also mention here that at a certain stage of growth of our *Ctenolabrus* the young show a very decided tendency to lean on the right side. This is even seen in fully grown specimens, in the peculiar slanting position often taken by individuals when they approach an obstacle.

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THE FORMER RANGE OF SOME NEW ENGLAND CARNIVOROUS MAMMALS.

BY J. A. ALLEN.

THE geographical range of the larger mammals of New England is well known to have been much more extended formerly than it is at present. Not only have most of the larger species greatly decreased in numbers throughout the more thickly settled portions of the Eastern States, but not a few have become extirpated over regions where they were formerly abundant. This restriction of range and numerical decrease are obviously due to man's agency. Most of the carnivorous species existed in such numbers at the time of the first settlement of the country by Europeans that their presence was a great check upon the rearing of stock, and even a source of danger to human life. Hence, naturally, an exterminating warfare was speedily begun upon them, which was stimulated by the offer of rewards by the local authorities for their destruction. As I have elsewhere shown,[1] the money paid for the destruction of noxious animals often amounted to a very large draft upon the treasuries of the different towns, in some instances nearly equaling the amount expended for all other purposes. The offer of rewards for their capture proved, as was intended, a great incentive to their destruction, but since many of the carnivorous species yielded also products of a high commercial value, they were likewise eagerly pursued for their furs. In the case of the beaver, the fisher, the sable, and the musk-rat, the demands of the fur trade alone tended to the rapid decrease of a few species not among the legally proscribed. The different species of the deer family were hunted both for their flesh and for their skins. Add to these incentives the pleasures of the chase, which to a large class of sportsmen are a more satisfactory reward than its more tangible products, and the almost incredibly rapid decrease of many species need be no longer a subject of surprise.

The early accounts of the exploration and settlement of New England abound with references to the abundance of the game animals of the country, and furnish reliable evidence of the former more extended range of many of the species and the much greater abundance of all. The woods are often spoken of as filled with wild animals, among which the most numerous were beavers, foxes, wolves, bears, moose, deer, raccoons, and martens; lynxes were common, as was also that "most insidious and deadly foe of human kind, the catamount." The range of the catamount or panther (*Felis concolor*) extends, as is well known, from Northern New England southward not only to the Gulf of Mexico, but throughout the greater part of South America. It long since, however, disappeared from the southern half of New England, as well as from most of the more settled parts of the United States everywhere; the capture during the last ten years of an occasional individual in the Green Mountains and in the forest region of Northern New Hampshire and Maine shows that it still lingers in Northern New England, where it is slowly but surely becoming extirpated. The lynxes (*Lynx Canadensis* and *L. rufus*[2]), doubtless always far more numerous than the panther, are still taken at long intervals throughout most of Southern New England, where they are, however, nearly exterminated; in the forests of the more northerly parts they are still more or less frequent.

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[1] Penn Monthly, October, 1876.

[2] As I have recently pointed out (Bulletin United States Geological and Geographical Survey of the Territories, ii. 222–225, July, 1876), these so-called species, if distinct, are to be distinguished by merely slight differences of coloration, consisting mainly in the grayer tints and less distinct markings of *L.* "*Canadensis*" as compared with *L.* "*rufus*," especially in the tendency to obsoleteness of the transverse

In early days the gray wolf (*Canis lupus*) was abundant everywhere, and as early as 1630 became an outlaw in the Plymouth Colony. In that year the court ordered that any Englishman who killed a wolf should have one penny for each horse and cow, and one farthing for "each sheep and swine," owned in the colony.[1] In 1698 the town of Lynn voted to allow a premium of twenty shillings for every wolf destroyed in the town.[2] Many writers refer to its great destructiveness to sheep and calves, and to its roaming at night in large packs. They also describe it as presenting a great variety of colors, showing that the same diversity of color occurred among the wolves of Southern New England that has been noticed among those of other sections of the country. Thomas Morton, in a work published in 1637,[3] says, "The wolfes are of divers coloures: some sandy coloured: some griselled, and some black. . . . . The skinnes are used by the Salvages, especially the skinne of the black wolfe, which is esteemed a present for a prince there."

It is now many years since the last wolf was seen in New England east of the Connecticut and south of New Hampshire, but as late as the beginning of the present century it was abundant in Southern Maine as well as in Southern Vermont and New Hampshire, and was of rather frequent occurrence in the mountainous portions of Western Massachusetts. None are now found south of Northern Maine and the White Mountains.

The gray fox (*Urocyon Virginianus*) is well known to have formerly ranged much farther northward than it does now. Even within the last thirty to fifty years it has disappeared over considerable areas along the northern border of its habitat. Extending northward formerly to the Great Lakes, it seems now to have nearly disappeared north of the Ohio River. It is also

markings on the inside of the fore legs. . *L.* "*Canadensis*" being a more northern form than *L.* "*rufus*," it generally has longer, softer, and fuller pelage, and the pads of the feet are more fully covered; it has consequently the appearance of being larger, but measurements of specimens in the flesh, as well as of a large number of the skulls of each, show the difference to be more apparent than real, and due to the greater length and fullness of the pelage. Hunters and trappers, however, recognize certain characteristic differences of habit, and call the two forms by different names.

[1] Lewis's History of Lynn (edition of 1829), page 37.

[2] Ibid., page 144.

[3] New English Caanan, page 79.

well known to have once inhabited the Atlantic States eastward to Southern New England. Dr. Emmons recorded it as "rare" in Massachusetts in 1840; Audubon and Bachman speak of it as not uncommon in the vicinity of Albany, N. Y., but as rare in New England. It is explicitly described as an animal of Massachusetts by some of the early writers, but I have heard of only one or two instances of its recent capture in this State.

At the southward, particularly in Pennsylvania and Virginia, the gray fox seems to have been the prevailing species at the time of the arrival of Europeans, there being, among the numerous early enumerations of the animals of this region, frequent and explicit allusions to this species, while the red fox is rarely mentioned. Kalm, in speaking of Pennsylvania, says, "The red foxes are very scarce here; they are entirely the same with the European sort. Mr. Bartram and several others assured me that according to the unanimous testimony of the Indians this kind of foxes never was in this country before the Europeans settled it. But of the manner of their coming I have two different accounts. Mr. Bartram and several other people were told by the Indians that these foxes came into America soon after the arrival of the Europeans, after an extraordinary cold winter, when all the sea to the northward was frozen; from thence they would infer that they could perhaps get over to America upon the ice from Greenland or the northern parts of Europe and Asia. But Mr. Evans and some others assured me that the following account was still known by the people. A gentleman of fortune in New England, who had a great inclination for hunting, brought over a great number of foxes from Europe, and let them loose in his territories, that he might be able to indulge his passion for hunting. This is said to have happened almost at the very beginning of New England's being peopled with European inhabitants. These foxes are believed to have so multiplied that all the red foxes in the country were their offspring. At present they are reckoned among the noxious creatures of these parts. . . . . In Pennsylvania, therefore, there is a reward of two shillings for killing an old fox, and of one shilling for killing a young one."[1] Forster, however, in a foot-note to Kalm's work (*loc. cit.*, pages 283, 284) dissents from this theory and believes that they reached America from Asia, and cites the fact of Commodore Behring's meeting with them when he landed on the west coast of America. Professor Baird calls attention to the fact that no remains of the red fox have been found in the Carlisle and other bone caves of Pennsylvania, while those of the gray fox are abundantly represented there. "This," he adds, "would almost give color to the impression somewhat prevalent that the red fox of Eastern America is the descendant of individuals of the European fox imported many years ago and allowed to run wild and overspread the country. The fact of their present abundance and extent of distribution is no barrier to the reception of this idea, as the same has been the case with horses, brought over by the Spaniards after the discovery of America, and set at liberty."[1] In a recent number of *Forest and Stream* (October 5, 1876), Mr. Alexander Hunter quotes Colonel T. B. Thorpe as saying, "The red fox is supposed to have been imported from England to the eastern shore of Maryland, and to have emigrated to Virginia on the ice in the severe winter of 1779, at which time the Chesapeake was frozen over. In 1789 the first red fox that we have any record of was killed in Maryland. In that year there had been a few red foxes turned loose on Long Island."

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[1] Kalm's Travels, Forster's Translation, i. 283, 284.

That the red fox was an abundant species from New York northward, however, as early as the sixteenth century is a fact as well substantiated as that of the existence there of the wolf or beaver. The red fox was seen by Jacques Cartier on the Saguenay River in 1535 and 1536. Its occurrence in great numbers in Newfoundland as early as 1590 to 1620 is repeatedly mentioned by Richard Whitboune and other contemporary explorers. In 1603 Martin Pring found foxes so abundant on an island in latitude 43° that he named it Fox Island. He also speaks of meeting with great numbers on the main-land in latitude 43° 30′. Morton likewise refers to their abundance in Massachusetts prior to 1637. The first settlers of the town of Lynn found them to be annoyingly numerous, and in 1698 voted to pay a reward of two shillings a head for their destruction. Lewis states, in his history of the town, that the town records show that between this date and 1722 the destruction of four hundred and twenty-eight foxes was paid for by the town, all of which were killed in the "Lynn woods and on Nahant."[2] In the enumeration of the peltries exported from Quebec during the single year 1786, 6213 fox skins are mentioned.[3] It is also stated that the records of the Pynchon family show that between the years 1654 and 1674 the Pynchons packed and exported to England from the Connecticut Valley, among other peltries, "large quantities of fox skins."[1] The first settlers of Maine and New Hampshire also found the fox there in great abundance. These various references to the fox in New England also show that its several varieties, as the "black,"[2] "gray," and "cross" foxes, were of frequent occurrence as far south as Massachusetts and New York.

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[1] Mammals of North America, page 130.

[2] Lewis's History of Lynn, edition of 1829, page 144.

[3] Mass. Hist. Coll., vi. 57.

This shows conclusively that while English foxes may have been taken to America and turned loose by the early colonists, the more northerly portions of the Atlantic coast region abounded with this animal long before its reported importation from England, and hence that the theory that the red fox of North America is of recent European origin is wholly unfounded. Were there not direct evidence to the contrary, it is highly improbable that the millions of foxes existing throughout the northern half of the continent, where this animal was found in great abundance wherever the first explorers penetrated, could have originated from the few imported to New England and Maryland in the seventeenth and eighteenth centuries, and thence spread throughout the vast interior, westward to the Pacific and northward to the arctic circle.

The apparent absence of its bones, however, in the bone caves of Pennsylvania, where have been found the semi-fossil remains of nearly all the other existing mammals of that region, together with its known absence or at least great scarcity there when Europeans first settled that State, seems to show conclusively that it has spread considerably southward along the Atlantic coast during the last two hundred years, and that the gray fox has receded before it.

Notwithstanding the constant persecution to which this animal has been subjected, it is still of more or less frequent occurrence throughout New England, and through its consummate cunning has even been able to extend its range over considerable areas since the first settlement of the country.

The early records show that both the fisher (*Mustela Pennanti*) and the marten (*Mustela Americana*) were common inhabitants of not only the whole of New England, but also of the Atlantic States generally, as far southward as Virginia (excepting possibly a narrow belt along the seaboard), and even farther southward along the Alleghanies. None, however, now exist in the United States east of the Mississippi River, south of Northern New England and Northern New York, except at a few points in the Alleghanies. They were occasionally found in Western Massachusetts a generation since, but they probably rarely if ever occur there now. Being eagerly hunted for their furs they soon disappeared before the advancing settlements, and linger only in such wooded regions as are least frequented by man. The mink (*Putorius vison*) and the weasels (*P. ermineus* and *P. vulgaris*) are still generally distributed, but in all the more thickly-settled parts of New England they long since became comparatively infrequent, though still numerous in the northern forests. The otter (*Lutra Canadensis*) and the raccoon (*Procyon lotor*), both formerly abundant, are now everywhere rare in Southern New England, over large portions of which they have become quite extirpated. The wolverine (*Gulo luscus*), now rarely recognized as an animal that was ever found in New England, seems to have been formerly of frequent occurrence in the northern parts of Vermont, New Hampshire, and Maine, and probably once inhabited the highlands of Western Massachusetts. Samuel Williams, writing in 1794, cites it as an inhabitant of the "northern and uncultivated parts" of Vermont,[1] and Hanson says it was formerly found in Maine, while their accompanying descriptions of the animal leave no doubt of the correctness of their identifications.

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[1] Temple and Sheldon's History of Northfield, Mass., page 49, foot-note.

[2] In the early records the fisher (*Mustela Pennanti*) is also usually called the "black fox."

The black bear (*Ursus Americanus*[2]) is well known to have been of very frequent occurrence throughout not only New England, but the whole of Eastern North America. Still occasionally taken in the Green Mountains even as far south as Northern Connecticut, it is probably wholly extinct east of the Connecticut River south of the White Mountains. Though comparatively frequent in some portions of Northern New England, it is even there much more rare than formerly.

The polar bear (*Ursus maritimus*) seems never to have quite reached the New England coast, though its range southward extended much farther than has been generally heretofore recognized, as is unquestionably proven by the following extract from the account of Jacques Cartier's voyage to Newfoundland in 1534. In his account of the "Island of Birds," situated off the coast of Newfoundland, it is stated, "And albeit the sayd island be fourteen leagues from the maine land, notwithstanding beares come swimming thither to eat of the sayd birds, and our men found one there as great as any cow, and as white as any swan, who in their presence leapt into the sea; and upon Whitsunmunday (following our voyage toward the land) we met her by the way, swimming toward land as swiftly as we could saile. So soone as we saw her we pursued her with our boats, and by main strength tooke her, whose flesh was as good to be eaten as the flesh of a calf of two yeares old."[1] Though formerly occurring in considerable numbers along the coast of Labrador, it was probably never common as far south as Newfoundland. According to Dr. Packard[2] the polar bear was occasionally obtained off the coast of Labrador as late as 1864, whither it had apparently drifted on floating ice brought down from the north by the polar current.

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[1] Natural and Civil History of Vermont, page 87.

[2] A recent reëxamination of the specific relationship of the North American bears, based on the large collection of skulls contained in the National Museum (see Bulletin of the United States Geological and Geographical Survey of the Territories, ii 334–340), has convinced me of the specific distinctness of *U. Americanus* auct. from the *U. arctos* of the Old World, from which latter, however, the *U. horribilis* is distinguishable as a geographical subspecies. The *U. cinnamominus* seems not separable from *U. Americanus* even as a geographical subspecies, and the *U.* "*horriæus*" seems to be similarly undistinguishable from *U. arctos* var. *horribilis*.

The walrus, though its remains are found in a fossil state as far south as South Carolina, probably did not quite reach the New England coast at the time it was first explored by Europeans, though found in large numbers during the middle of the sixteenth century as far south as Sable Island, off Cape Breton, Nova Scotia, and on the Magdalen and other islands in the Gulf of St. Lawrence. The common harbor seal (*Phoca vitulina*) is still more or less common at suitable localities along the New England coast, but its numbers are far less than formerly. Some of the larger seals are also still found along the coast of Maine, but their present southern limits and former range I have been as yet unable satisfactorily to determine.

[1] Hakluyt, Voyages, iii. 250, 251.

[2] Proceedings of the Boston Society of Natural History, x. 370.

ROCK-INSCRIPTIONS OF THE "ANCIENT PUEBLOS" OF COLORADO, UTAH, NEW MEXICO, AND ARIZONA.

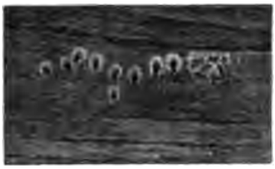
BY EDWIN A. BARBER.

THE picture-writings or hieroglyphics of this ancient architectural and agricultural race consisted of *ideographs*, or symbols representing ideas, the object pictured standing for the word to be expressed. So we can see that the method employed for recording events was very imperfect and limited, reaching scarcely beyond the *nouns*, although in some cases they represented *action*, or *verbs*, as in the sketching of men dancing or running. By a careful study of these pictographs and rock-etchings, much relative to these people can be obtained, although many of the symbols are not decipherable. Indeed, it has not been proved that there was any *regularity* or *method* in thus recording events; we know not whether each historian used a peculiar mode of his own for the transmission of ideas, or whether there was a recognized plan which the most educated of the tribe adopted.

I noticed that throughout those ancient inscriptions which are undoubtedly coeval with the ruined buildings and which appear in their vicinity, a common representation was that of an animal closely resembling the domestic goat. This may have been intended for the Rocky Mountain sheep or big-horn, as this animal was plentiful throughout the country four centuries ago, although now it does not occur along the valley of the San Juan River. The horns are represented as long, heavy, and curved backwards. As the goat is not indigenous to America, the flocks or herds of the ancients consisted probably of some of the domesticated wild animals which abounded in that country. The Rocky Mountain goat is in reality an antelope; the big-horn once roamed through Arizona and the mountains of New Mexico. We discover from the accounts of the early Spaniards, who penetrated through this country, that many tribes of Indians which peopled it possessed flocks and herds, though of what nature, we are not informed. Many of the natives clothed themselves in garments made of the hair of the wild sheep, while other tribes wore cotton clothing. Coronado in 1540 wrote of the country of Cibola or Zuñi, "Here are also wild goats, whose heads likewise I have seen." These were probably the Rocky Mountain goats or sheep. Gomara (another Spaniard) remarks in his history relative to this country, about the same time, "There are also great dogs which will fight with a bull, and will carry fifty pounds' weight in sacks when they go on hunting or when they remove from place to place with their *flocks* and *herds*."

The horse was not known to the natives of America at the time of the conquest, although remains of it occur in a fossil state. Therefore we find no representation of this animal in the ancient inscriptions.

Throughout this entire country the Navajo Indians and the Utes and Pah-utes have covered the walls of bowlders with representations of more recent date, in which the horse figures conspicuously; but these inscriptions can be readily distinguished, by an experienced eye, from those possessing on their very faces the impress of centuries. Indeed, some of them have become entirely effaced, and others are so nearly obliterated that it is only after the most careful study and the most attentive observation that they can be at all distinguished. We do not find in this section many *painted* or *colored* representations; the majority of them are etched or engraved in the rock by the agency of stone implements, such as chisels, awls, etc. In the vicinity of nearly every important congregation of structures these are common on the cliffs and vertical rock-faces. Often they are found in the most inaccessible places and in the neighborhood of the more dangerously located cliff-dwellings. Sometimes they can be descried on a perpendicular wall at a height of hundreds of feet, between the valley below and the summit of the mesa above, but how they could have been cut there we are at a loss to conjecture. They must have been engraved in such cases either from the top of a very long ladder, or by the operator being suspended from above by a long rope of rawhide or sinew; or there may have been, long ago, ledges in the now smooth face of the rock, and steps may have led up to the summit. Such an inaccessible inscription I noticed on a high wall on the north bank of the San Juan River, above the Rio de Chelly. The figures represented three immense centipedes, being several feet each in length, and situated at least two hundred feet above the river. The snake, turtle, and frog are common objects in the hieroglyphics, and these animals were probably held in veneration by the ancients, just as they are now by their descendants in New Mexico and Arizona, being looked upon as the lesser divinities of water. Rude human figures and hands, and feet of birds and animals, such as the eagle or bear, are numerous, but the commonest and most suggestive likeness is that of the human hand. In many of the ruins and frequently on the walls above cliff-houses are these representations to be seen in great numbers. They have been formed by placing the outspread palms against the rock and spattering mud or paint around them, leaving an accurate and natural-sized outline of the original. These we noticed of all sizes, frequently in pairs, with the thumbs touching. It is impossible to say whether they were intended to convey any particular idea, or whether they were daubed on the walls in idle moments. However, they are the most instructive objects of the ancient picture-writing, and give the ethnologist an important clew to the original people, in the shape, size, and appearance of the hands. We can see that some of them (probably those of children and females) were symmetrical, delicately molded, and beautiful, while many more (undoubtedly those of the adult laborers) were large, rough, and powerful. These occur more particularly in the *Casa del Eco* (a cave-house on the San Juan) and above a collection of cliff ruins near Epsom Creek, in Utah. The illustration (Figure 61) will convey a better idea of them.



(FIG. 61.) ANCIENT HAND-PRINTS ON THE ROCKS, NEAR EPSOM CREEK, UTAH.

Just to the west of Ute Mountain, on a bowlder of rock near the old Indian trail leading down the McElmo arroyo, in Southwest Colorado, is an ancient inscription representing a man, two deer or elk, and several characters intended for either the feet or the foot-prints of a human being, or of a bear (Figure 62). Now as there are deer and bear on the neighboring mountain, this may be the record of an event, and may possibly be translated thus: A hunter, observing the tracks of a bear, trailed him some distance, and instead of discovering the bear overtook two deer or elk, which he slew. The figures may be intended for either, probably the latter, one full-grown and the other smaller.

There have been no *written* accounts discovered among the remains of the "Ancient Pueblos,"[1] nothing but these hieroglyphics, and by the employment of the latter symbols the Indian tribes of to-day transmit accounts of their principal events to their children. Battles and unusual incidents of great ceremonies are thus recorded, as, for instance, on the interior of the canvas of a Ute *wick-e-up*, at the White River Agency, in Northwestern Colorado, I observed the elaborate representation of a battle in which the Ute tribe had been engaged against the Arapahoes. There were seven horses which had been captured, beside a bow and quiver of arrows, an elegant red pipe made of the Catlinite from the *Coteau des Prairies* and bound with silver bands, and some furs and blankets, while the captors were figured riding behind with scalps and other trophies dangling from their lances or spears. This was explained to me by the artist, one of the head men of his tribe, and the foremost in the skirmish. In another lodge at the same place I noticed the recorded history of a memorable buffalo or bison hunt.

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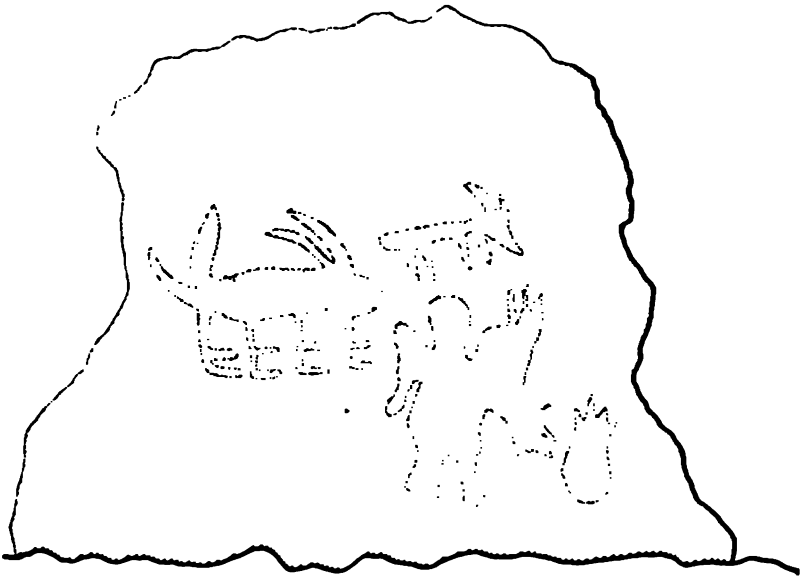
[1] Mr. J. H. Beadle says of the Zuñians who now occupy a town in New Mexico, "They formerly had the art of writing, but appear to have lost it in their many mutations. They preserve one book, but the last man who could read it died many years ago, and the priests regard it merely as a holy relic. It consists simply of a mass of finely dressed skins, bound on one side with thongs; the leaves are thickly covered with characters and drawings in red, blue, green — squares, diamonds, circles, serpents, eagles, plants, flying monsters, and hideous human heads. One of their *Caciques* says it is the history of their race, and shows that they have moved fourteen times, this being their fifteenth place of settlement."

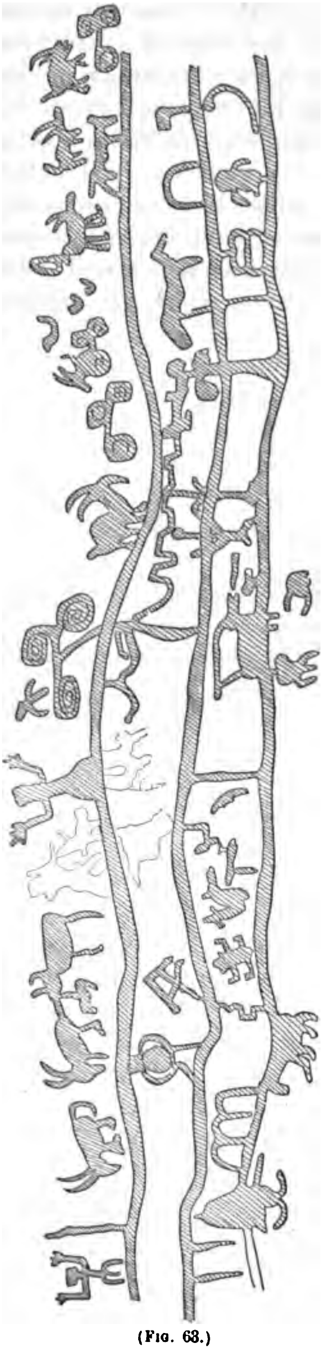


INSCRIPTION NEAR UTE MOUNTAIN, S.W COLORADO.

(FIG. 62.)

This method of perpetuating incidents has been employed by North American tribes for centuries, but beyond this neither advancement nor improvement has been made.

One of the best preserved and most interesting of ancient inscriptions we copied from the wall of a rock situated beneath some extensive ruins in the valley of the Hovenweep, where it joins the McElmo in Southwestern Colorado. Sheltered by an overhanging ledge, the original characters had been tolerably well preserved from the elements, but the wind constantly sifting fine sand against it had rendered the figures and lines in places somewhat obscure. The work had been done with a blunt chisel by pecking off little chips of the sandstone. The figures average a foot in height, and are arranged on three approximately parallel lines, which extend for perhaps fifteen feet. Figure 63 is a copy of the original. Here we see frequently pictured the mountain sheep (?), and we can recognize the snake, tortoise, and a bird flying out of a tree. There are also human beings, more birds, a bear, and numerous undecipherable characters. The legend may have been read along the lines, commencing at the left-hand upper corner, or it may have been perused after the Chinese manner, beginning at the other end.



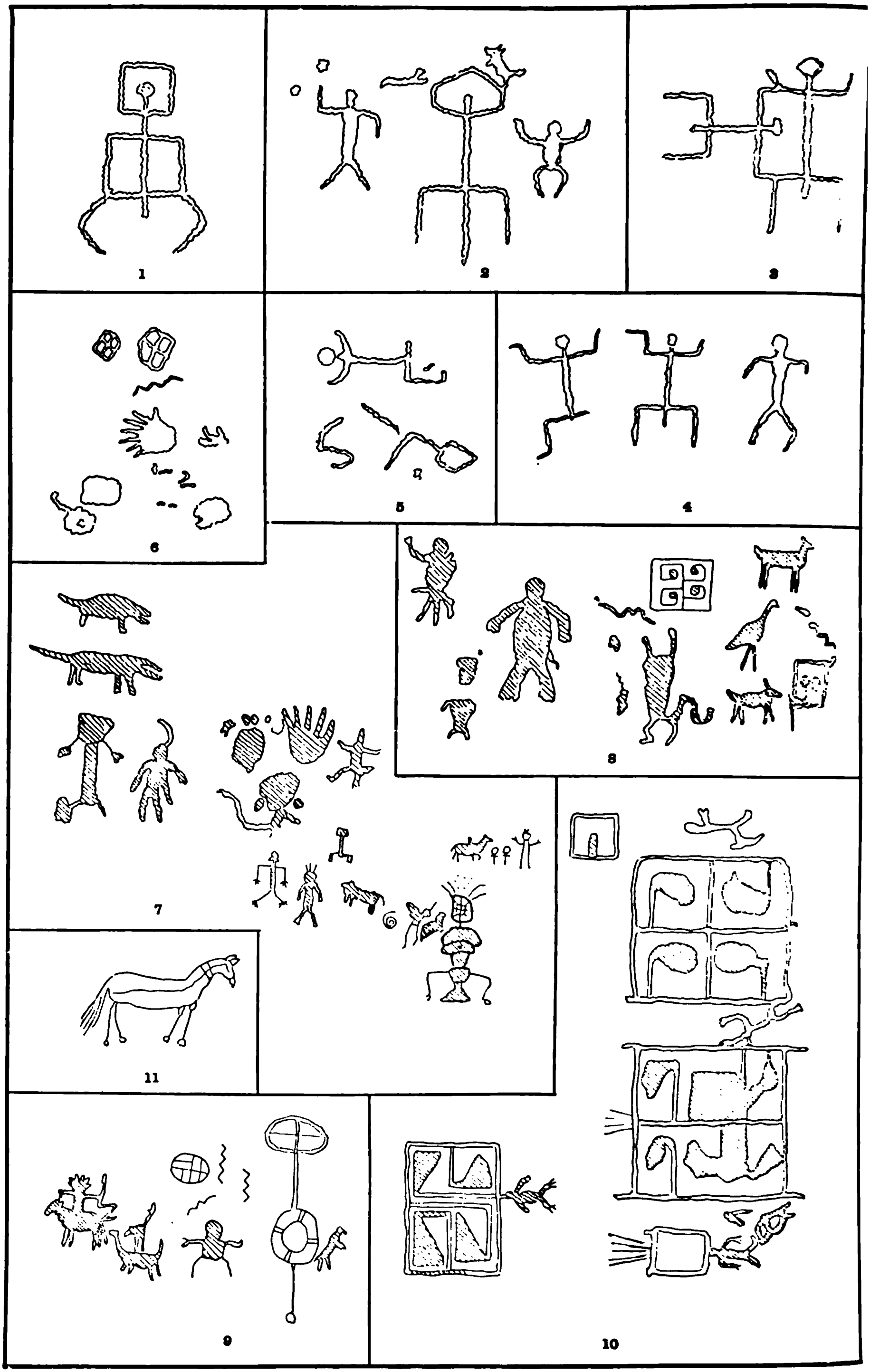
ANCIENT RECORD AT THE JUNCTION OF THE MCELMO AND HOVENWEEP, S.W. COLORADO.

(Fig. 63.)

In the Cañon of the Mancos Mr. W. H. Jackson discovered a simple inscription wherein are figured a bird, a goat (or deer), a man, and several snakes or ornamental designs.

Along the banks of the Gila Lieutenant Emory saw many etchings on the rocks which were probably the work of modern Indians. But "others were of undoubted antiquity, and the signs and symbols intended, doubtless, to commemorate some great event. One stone bore on it what might be taken, with a little stretch of the imagination, for a mastodon, a horse, a dog, and a man. Their heads are turned to the east, and this may commemorate the passage of the aborigines of the Gila on their way south." It is evident, however, that these etchings were of comparatively recent date, from the presence of the horse, unless the figure was designed for some other animal, which seems probable. The presence of the mastodon is also extremely doubtful, and we must indeed stretch our imaginations in order to believe that this ancient animal was known to these people and pictured in their hieroglyphs, for although their antiquity may be great, they certainly do not date back to the quaternary period.

Mr. W. H. Holmes, in charge of one of the branches of the United States Geological Survey of the Territories, discovered a number of singular inscriptions, some of them evidently of modern workmanship, but many of them of almost undoubted antiquity. Figures 1, 2, and 3, Plate XIII., were copied from the rocks near the Mancos in the vicinity of some of the cliff-houses. The majority of these figures were intended to portray the human form, though in grotesque shapes and attitudes. In Figure 2 may be seen one or two representations of animals, though what they may have been designed for it is impossible to determine. Figures 4, 5, and 6 occur near the others, painted in red and white clay. Mr. Holmes thinks that "these were certainly done by the cliff-builders, and probably while the houses were in process of construction, since the material used is identical with the plaster of the houses. The reproduction is approximately one twelfth the size of the original." The remainder of the figures on this plate and those given on Plate XIV. were seen ten miles below the mouth of the Rio la Plata, on the San Juan River. All of them have been etched in the rocks, and the bodies of the figures have been generally chipped out, sometimes to a depth of a quarter or a half of an inch. In Figure 8 of Plate XIII. we can distinguish several objects, as a bird, a deer, several fanciful designs, and two men with tails. These latter may represent monkeys, although from their size and appearance they resemble more a pair of tailed human beings. In Figure 7 occur two animals resembling huge lizards; they are probably intended for disproportioned sand-lizards, and not alligators. Figure 11 is without doubt a recent Navajo drawing of a horse. Figure 10 is comparatively ancient, somewhat resembling the prevalent patterns to be seen on the ancient pottery. Figure 9 is more modern, as may be seen from the presence of the horse.



Russell & Struthers N.Y.

PLATE XIII.

In Plate XIV., Figure 1 is a procession of animals, the majority representing deer and elk. The inscription is possibly intended to chronicle a great migration of an ancient tribe with their flocks and herds. At *c* is what appears to be a reindeer drawing a sledge which contains two human figures. Might not this be the record of a traditionary migration from the north? Through the procession are scattered men and birds, and two winged figures at *b b* seem to be hovering in the air. At *a* are two long-tailed animals resembling the American panther; they seem to be entering a trap. The whole picture is about one twelfth of the original in size.

Figures 2 and 3 are copies of portions of considerable inscriptions, these being the least obscure. They are evidently very old, and in many places almost obliterated. In Figure 2 can be distinguished several birds at *a a a*, the lower two in all likelihood representing eagles; *b* is an unknown animal, possibly a bear; *c* is a geometrical design for ornamentation; *d* may be a representative of the family of marsupials, and *e* a man. The figures of the etching are so complicated that it is difficult to distinguish many of them. In Figure 3 is a representation of a Rocky Mountain sheep at *a*; *b* resembles either a llama or a female deer; *c* and *d* are distorted images of the human form. There are also prints of birds' feet, and the upper figure appears more like a comet than anything else.

From the preceding remarks we see that the ancients possibly represented several animate objects, which do not occur within the limits of the United States. It would seem, then, that they held communication with other tribes in widely separated sections. The presence of the reindeer makes it appear highly probable either that the people had reached their southern homes from the far north, or that they had at least held intercourse at one time with northern tribes. If we can identify the llama in their inscriptions, we establish the fact that they corresponded with the people of South America. This, however, is a matter of doubt, and we can arrive at no satisfactory conclusion from a careful examination of such rude figures.

The whole subject is enshrouded in an impenetrable obscurity, and all our attempts to pierce it result in conjecture and doubt. That many of the hieroglyphical records are very ancient we cannot deny, yet it is impossible to know where to draw the line of separation between such and those of more modern date. The oldest, and those of undoubted coexistence with the most ancient

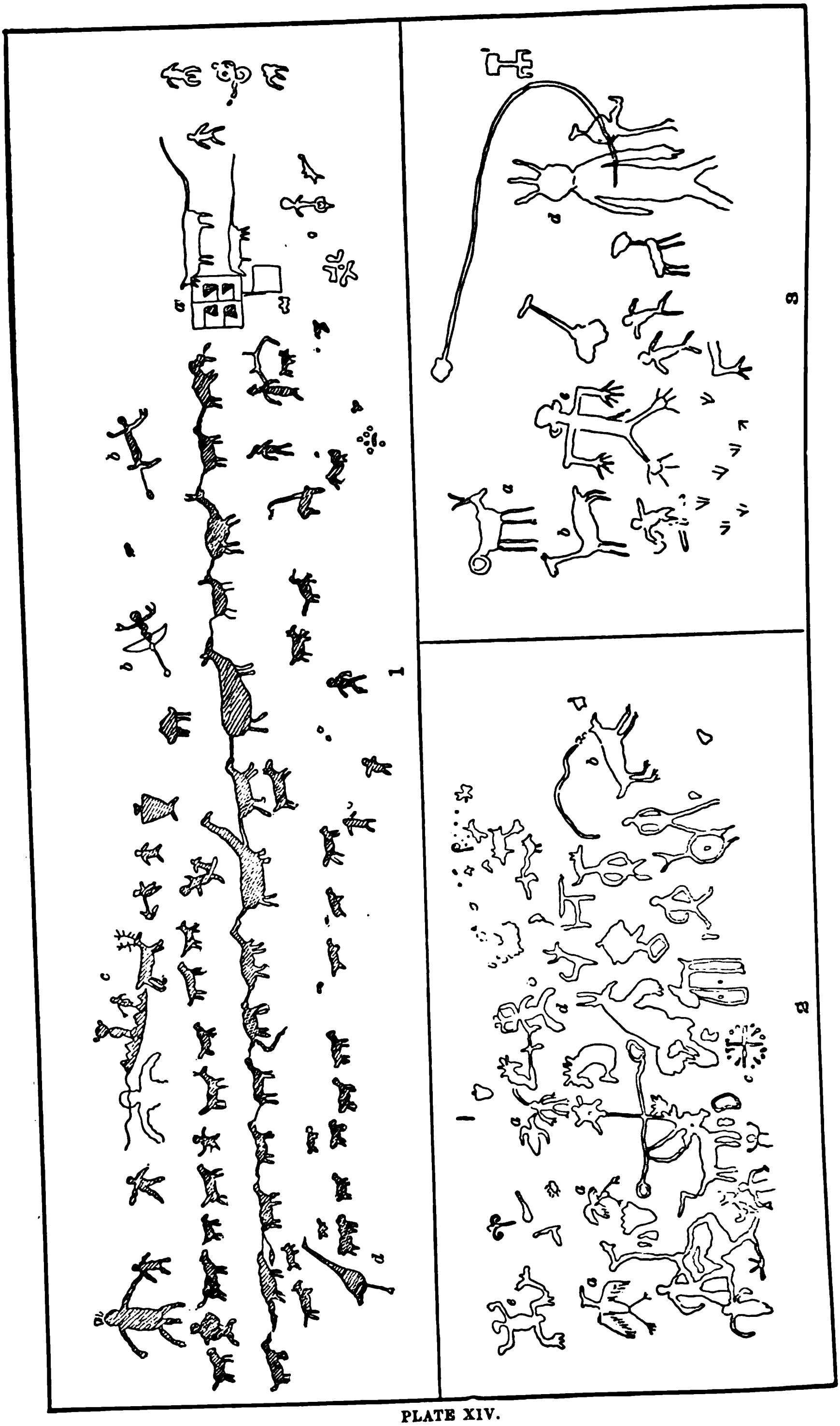


PLATE XIV.

of the ruins, are entirely obliterated by the ravages of centuries. We can simply go back a few hundreds of years and infer that these inscriptions may have been copied from still older ones, which have long since disappeared.

These discoveries are the results of the explorations of several parties of the United States Geological and Geographical Survey of the Territories, in charge of Prof. F. V. Hayden, and Plates XIII. and XIV. have been kindly furnished to me by him for this paper.

MICROSCOPY AT THE INTERNATIONAL EXHIBITION.

BY R. H. WARD, M. D.

IN briefly reviewing the microscopes exhibited at the American Centennial Exhibition, just closing at Philadelphia, it will be convenient to classify them in three more or less natural groups: the Continental, English, and American. All these classes are largely and characteristically represented by the most interesting and in many cases by the most distinguished examples of their kind, affording to microscopical students the best opportunity yet furnished in this country to study and compare the various types and qualities of tools available for their work.

It will be expedient to mention first, however, a few isolated and unclassifiable exhibits which are still of sufficient interest to demand a passing notice, such as a very small upright educational microscope of no well-marked character, from Switzerland; a small instrument from Tokio, Japan, which is evidently an early if not a first attempt, and a not unsuccessful one, though of unpretending form and crude workmanship, to imitate the instruments in vogue in this country a score of years ago; and a couple of large, clumsy instruments from Canada, one of them from Montreal and the other in the educational exhibit from Toronto, of which it can only be hoped that they do not fairly represent the science and art of our Canadian friends, since they are wholly devoid of any evidence of the spirit of that progress which has so fully and so fortunately changed the microscope from a piece of furniture to a tool for scientific work, and are in fact excellent illustrations of what a microscope ought not to be for educational purposes.

The continental microscopes are chiefly represented by the exhibit of Nachet, of Paris, whose compact, ingenious, elaborate, and thoroughly built instruments are present in large numbers and great variety, constituting, with one exception perhaps, the most exhaustive exhibit in our department. Besides the familiar Nachet stands, large and small, monocular and binocular, for one observer and for more than one, and of course the inverted microscope of Prof. J. L. Smith, which the manufacturer never should have allowed to pass as his own, there are dainty pocket microscopes in cases of wood or nickel-plated metal, clinical, tank, and dissecting microscopes, and a few accessories, which, though not absolute novelties, are at least not usually seen on sale in this country. The most conspicuous and possibly the most worthless article in this exhibit is a huge inverted microscope, as big as a small stovepipe, in which great amplification is gained by means of the great distance between the ocular and the objective.

Bardou and Son of Paris also exhibit, in connection with a large display of telescopes and other optical goods, one large instrument of the French style, having no important characteristics, and a few inferior instruments.

Austria is represented by S. Plossl & Co., of Vienna, whose little case contains a compact histological microscope of excellent design and attractive appearance. In place of a rack, a pair of arms attaches the body to the milled heads near their circumference, changing the rotary to a plunging motion, as if the driving wheel of a steam-engine moved the piston rod, and giving a very delicate adjustment just as the body approaches a state of rest. Accompanying this instrument is a clinical one, of the German style and far simpler than the French, English, or American forms.

The handsomest case of instruments in the English department, and indeed in the whole exhibition, is that contributed by the Ross house, of London. Less than this could hardly be true of a finely finished show-case well filled with their almost unequaled workmanship. With the exception of the new Wenham adaptation of the Jackson form of stand, and the series of new Wenham objectives which are understood to have been entered for competition and then permanently removed from the exhibition and the country, there is but little in the exhibit that would be called novel, most of the forms seen being the familiar and standard styles of several years past. No better commendation of the new stands, whose beauty is universally conceded, could be desired than is furnished by the old style Ross stands exhibited by their side. Notwithstanding the solid workmanship of the latter, and the care with which they were doubtless packed for transportation, the transverse bar which joins the body to the rack has in nearly every case given way under some unfortunate jar and become hopelessly though not conspicuously deformed. The untimely removal of the set of comparatively unfamiliar objectives from the exhibition could not have been an intentional breach of courtesy or propriety, but was certainly an unfortunate mistake on the part of both the proprietors who desired and the officials who permitted it.

R. and J. Beck's exhibit is perhaps the most complete in the exhibition, but is so badly displayed as to present a scarcely attractive appearance. The large number of standard forms and the numerous and convenient accessories made by this firm have been so extensively exhibited and sold in this country that their peculiarities are well known. The chief novelties are a much-needed addition of centring and rotating adjustments to the substage, and a showy introduction of aluminium mountings in some of the stands.

Henry Crouch, of London, also exhibits a full series of instruments characterized by a greatly improved quality of moderate-priced work, a class of work for which there is an increasing appreciation and a growing demand. His best stands of medium size lack scarcely any advantage as compared with far more clumsy and costly first-class stands. His variety of accessories is large and well selected, showing an earnest endeavor to adopt the best novelties from every source. His manufacture of a small histological instrument, with short body, low stage, and horse-shoe base, after the Continental method, is one more evidence of the growing favor with which such instruments are regarded in England and America, especially as it is sold at a price greatly disproportionate to its size and elegance.

Of Negretti and Zambra it need only be said that along with other goods they display a small variety of microscopes, of which but one, the largest, is notable, and that merely for its bigness. It belongs to the furniture style of instruments, and so does its large case of accessories. Precisely the same words may be applied, except as to numbers, to the two huge instruments of J. H. Dallmeyer, the smaller of which is, in the writer's judgment, too large for any known use.

The class of American instruments, though not as distinct a group as the other two, is mentioned separately for local reasons as well as on account of some peculiarities which its members have in common. Certainly first among these is the exhibit of

Joseph Zentmayer, of Philadelphia, who offers the most elaborate and elegant instruments as well as the largest variety of different forms. His ingenious contrivances and excellent brass-work are too familiar to need description. He shows the large American, intermediate, hospital, and clinical stands, and the new student's, introduced a few years ago to meet the demand for histological instruments ; also a material modification of the American, introduced this summer and known as the model, having the three new features of a fine adjustment by a long slide close behind the rack and moved by a screw and lever nearly in the Ross position, an interchangeable stage which can be almost instantly removed and replaced by an extremely thin diatom stage, and a bar, which carries the substage and mirror, hinged at the level of the plane of the stage so as to enable the illuminating apparatus to revolve with facility and in an easily measured position around the object as a centre. He also exhibits a new pocket microscope of neat and apparently serviceable construction.

T. H. McAllister's case, in the photographic building, exhibits his two or three grades of instruments, with chain movements, thin stages, and often iron bases, built with a view to both economy and excellence ; and also a new-model physician's microscope, which is literally a charming little instrument, very portable and handsome, and combining with most of the excellencies of the maker's former work the Zentmayer glass sliding stage and the diaphragm in the stage close to the object. The objectives furnished with it vary from fair to the best, according to the pecuniary views of the purchaser. The accessories are of the usual forms.

Bausch and Lomb, of Rochester, who have lately added to the province of the Vulcanite Optical Instrument Company, of that city, a microscopical department, under charge of E. Gundlach, formerly of Germany and late of Hackensack, N. J., exhibit a large series of entirely new designs. These are all of excellent workmanship, though of low or medium grade as to size, complexity, and cost. By simplifying the designs, introducing vulcanite into the mountings where it can be done to advantage, and introducing the business principle of attempting to create a large demand by production at a very low cost, the experiment of offering good instruments at a very low rate is being tried on a scale and with facilities unprecedented in this country. The special peculiarities of these stands, aside from the vulcanite mountings, are the hinging of the substage bar at the level of the object, contesting in this respect the priority with Zentmayer's new stand; a new object carrier, which with some improvements may be convenient; a new fine adjustment, by means of a screw acting on the body, which is supported at the end of two parallel horizontal springs, which allow a peculiarly smooth motion practically incapable of deterioration from wear or any other probable cause; and a coarse adjustment, consisting of a slide at the upper part of its course, and, below, a rapid screw which prevents pushing the body suddenly through the slide, and, without interfering with a prompt adjustment of low powers by sliding, gives a delicate adjustment for higher powers by screwing. This method is evidently a modification of Wales' oblique slot.

George Wales' new student's microscope is exhibited by the Stevens Institute of Technology. This is indeed an educational microscope and not a burlesque on the claim of the instrument to educational value. It is a small and compact stand, of the continental style, with horse-shoe base and low stage, of most substantial workmanship, adopting the Zentmayer glass stage, and introducing an original coarse adjustment by means of a sliding tube with the addition of a pin moving in an oblique slot and giving a rapid and very steady and safe adjustment by means of a screwing movement, and an iris diaphragm capable of being used after the continental plan close to the object slide, consisting of a thin split tube whose blades are overlapped and gradually closed by being screwed up into a dome-shaped cavity in the bottom of the stage plate. The instrument is furnished with Wales' excellent lenses.

James W. Queen & Co. exhibit their instruments, which are of the English type, reduced and adapted to the student's microscope grade, and aim rather to combine well-known excellencies into a good and popular instrument, than to introduce novelties of construction.

The instruments by W. Y. McAllister, in the Pennsylvania State Educational Exhibit, do not seem to suggest any of the progress of recent years.

A set of William Wales' exquisite lenses was exhibited by Mr. Zentmayer, but was unfortunately allowed to be prematurely removed from the case.

Several makers are conspicuous by their absence. All visitors to this department would have been glad to see Hartnack, and Powell, and Lealand, and the German makers, well represented;

and many felt disappointed at the absence of Spencer, of Tolles, and of Grunow, having very reasonably expected that such prominent American makers would from motives of fitness and courtesy, if not of interest, contribute their share to the completeness of the International Exhibition. It would have been peculiarly appropriate, in view of their undisputed excellence and their high claims, that the new duplex front objectives of Tolles should have been placed in comparison with the world's other lenses, while the unhandsome insinuation which is being extensively printed in advertisements, that they are not at the exhibition because they would not be properly examined there, must have been authorized without serious thought by the persons responsible for it. It is well known that President F. A. P. Barnard, who was associated with such judges in this group as Profs. Joseph Henry, J. E. Hilgard, and others scarcely less distinguished, gave his personal attention to the examination of the exhibits in this department.

Among the objects, other than microscopes, of special interest to microscopists, may be classed the double-stained vegetable preparations by Dr. Beatty, the large series of fine mounted objects by W. H. Walmsley, and the far from equal set of imported objects, both exhibited by James W. Queen & Co., and the more limited series of pathological specimens, by Dr. H. N. Krasinski, in the Russian department; the already famous machine for micro-ruling on glass, by Professor Rogers; the hitherto unequaled photo-micrographs, by Dr. J. J. Woodward, exhibited by the Army Medical Museum, and the good though less pretending attempts in the same direction, by Dr. Carl Seiler, in the photographic building; and the large, interesting, and carefully prepared series of minute fungi, with tinted drawings of the same, contributed by Mr. Thomas Taylor to the exhibit of the department of agriculture in that most creditable portion of the whole exhibition, the United States Government Building.

BASTIAN AND PASTEUR ON SPONTANEOUS GENERATION.

BY HENRY J. SLACK.

IN the number of *Comptes rendus* for July 10, 1876, is a paper by Dr. Bastian, On the Influence of Physico-Chemical Forces in the Phenomenon of Fermentation, intended to demonstrate, in opposition to the theory of atmospheric germs, that certain organic liquids contain complex chemical bodies which are capable of organization, and form different kinds of bacteria.

In support of these notions he recites experiments on urine caused to boil and screened from the influence of atmospheric germs. To determine the production of bacteria in this urine he introduced potash and oxygen, and subjected it to 122° F. He states that in numerous trials, urine previously rendered sterile and heated as just stated gave rise to bacteria. He found that a temperature of 122° F., though not generally considered favorable to fermentation, was so to the development of bacteria in urine and some other organic liquids.

In the autumn of 1875, he says, he found that urine, normal and acid, rendered sterile by ebullition, became fertile in two or three days when exactly saturated by potash, without other contamination, and after being exposed to an elevated temperature. He further states that he took the most minute precautions to avoid the influence of germs that might have been in the potash or on the walls of the vessels employed, as well as those which the air might carry.

He also states, with regard to the influence of oxygen, that urine rendered sterile, neutralized by potash, and subjected to electric action through platinum wires, gave remarkable results, fermenting rapidly at 122°, and becoming filled with bacteria in from seven to twelve hours. He considers that these experiments overthrow the atmospheric-germ theory, and cites Tyndall to the effect that bacteria germs are destroyed by a temperature of 212° maintained for a minute or two, as was the case with the fluids he used.

In *Comptes rendus* for July 17th, M. Pasteur makes a very polite reply, tinged with a little irony, in the remark that the heterogenists are more fortunate than the inventors of perpetual motion, in the lengthy attention they have received from scientific bodies. In the domain of mathematical sciences it is, he says, possible to demonstrate that certain propositions cannot be true, but natural sciences are less able to predict results. The mathematician may disdain to cast his eye upon an essay which has for its object squaring the circle, or perpetual motion; but the question of spontaneous generation excites public opinion, because it is impossible in the actual state of science to prove *a priori* that no manifestation of life can take place by a jump, without the previous existence of a similar life.

When any observer announces that he has discovered the conditions capable of causing the spontaneous origin of life, he is sure of the prompt adhesion of the systematic supporters of his doctrine, and of raising a doubt in the minds of others, who have acquired only a superficial knowledge of the subject. This is the more the case when an author, like Dr. Bastian, occupies an important position, has literary and dialectic talent, and brings forward conscientious researches.

During the twenty years he has worked at this question, M. Pas teur says he has not been able to discover any life not preceded by a similar life. The consequences of such a discovery would be incalculable. Natural sciences in general, medicine and philosophy in particular, would receive an impulse of which no one could foresee the consequences, and if any one succeeds in reaching such a result, he would welcome the happy investigator on his operations being proved. At present his attitude is one of defiance, as he has so often shown how readily able men make mistakes in this difficult art of experimentation, and what danger is connected with the interpretation of facts.

Let us see, he exclaims, whether Dr. Bastian has known how to escape these two rocks. He then cites the title of Dr. Bastian's paper and his chief remarks, and adds that he hastens to declare that the experiments described would usually give the results that are stated, and that he need not have operated at a temperature of 50° C., as at 25° or 30°, and even lower, boiled urine rendered alkaline by potash in a pure atmosphere becomes filled with bacteria and other organisms." If Tyndall, as Dr. Bastian says, thought this was not so, it must have been through forgetfulness. Dr. Bastian cannot be unaware that the experiments he has just communicated to the academy, or at least experiments of the same kind, were made by me, and published in a memoir in 1862, entitled On Organic Corpuscles which exist in the Atmosphere: an Examination of the Doctrine of Spontaneous Generation. I demonstrated in this paper (pages 58, 66) that acid liquids which always become sterile by a few minutes' exposure to 100° C. are made fecund if we communicate to them a slight alkalinity. The novelty introduced by Dr. Bastian in having recourse to a temperature of 50° C. is only apparent, since this condition is superfluous. There is, then, between us only a difference in the interpretation of facts common to both. Dr. Bastian says these facts prove spontaneous generation, and I reply, Not at all; they only demonstrate that certain germs of inferior organisms resist a temperature of 100° C. in neutral and slightly alkaline solutions, doubtless because under such conditions their envelopes are not penetrated by the water, and that they are so if the medium in which they are heated is slightly acid. In reference to this I will recall that the workmen of Rouen, as M. Pouchet informed us, noticed that certain seeds attached to wool coming from Brazil germinated after four hours' exposure to boiling water, and M. Pouchet proved that when the germination occurred after such treatment the grains had preserved their natural size, their hard, horny envelope not having been penetrated by water or steam; when the contrary was the case, germination was impossible. With regard to germs disseminated in atmospheric dust, I proved that they perished in an acid medium at 100° C., but they remain fertile if the medium is alkaline. (See page 65 of my paper.)

"If Dr. Bastian wishes to assure himself of his errors of interpretation, he can easily do it. He obtains bacteria by saturating boiled urine with potash. I simply suggest that instead of employing an aqueous solution of potash, he should drop into the urine solid potash after making it red-hot, or even only to 110° C. His experiment will then never succeed; that is, he will obtain no formation of bacteria in urine exposed to 30°, 40°, or 50° C. The conclusion he has drawn from our common experiments is thus inadmissible, for it would be absurd to pretend that the *primum movens* of life is in melted caustic potash. Such is the way of obtaining a decisive result. In one word, I only ask Dr. Bastian to eliminate the bacteria germs which were contained in the aqueous solution of potash he employs. If Dr. Bastian finds it difficult from the apparatus he uses, and does not describe, to bring the potash to a red heat previous to cooling it and dropping it as a solid into the urine, let him, instead of heating it to 100° C., heat it to 110° C., and he will then find sterility if he operates with vigorous accuracy. If he still preserves his doubts, let him suppress the preliminary condition of causing the urine to boil; for it is a remarkable fact that urine in its absolutely normal state as it leaves the bladder of a healthy man remains sterile if a certain quantity of potash is dropped into it, with the precautions I have described in chapter iii. of my recent work on beer, to avoid contact with atmospheric germs. Dr. Bastian conscientiously seeks the truth, and no alternative conclusion is possible. I entertain the firm hope that he will abandon his belief in spontaneous generation and in the proofs he supposes he has adduced."

M. Pasteur at the close of his paper stated verbally that, although the urine of a healthy man contains no extraneous germs of organic bodies, in most cases it comes into contact with such germs at the moment of its emission at the extremity of the urethral canal, or in the surrounding air. He also described the very simple apparatus he employed to repeat Dr. Bastian's experiments with decisive results. It is a pity that no details of this are given in *Comptes rendus.*

Dr. Bastian's reply to Pasteur's criticism, and the latter's rejoinder, will be found in *Comptes rendus* for July 31st and August 7th; they add nothing to the preceding. — *Monthly Microscopical Journal, October.*

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THE DESTRUCTION OF BIRDS BY TELEGRAPH WIRE.

BY DR. ELLIOTT COUES, U. S. A.

THIS is a subject which has already attracted deserved attention in Europe, and I believe that much has been said about it, particularly by German writers. But in this country the facts in the case seem to have been to a great degree overlooked, or at any rate insufficiently set forth in the random notices which, like the accounts of the mortality caused by light-houses, have occasionally appeared. Yet the matter is one of much interest, as I shall here take opportunity to note. Few persons, probably, even among ornithologists, realize what an enormous number of birds are killed by flying against these wires, which now form a murderous net-work over the greater part of the country. Until recently, I had myself no adequate idea of the destruction that is so quietly, insidiously, and uninterruptedly accomplished. My observations do not enable me to form even an approximate estimate of the annual mortality, and I suppose we shall never possess accurate data; but I am satisfied that *many hundred thousand* birds are yearly killed by the telegraph. The evidence I shall present may be considered sufficient to bear out a seemingly extravagant statement.

I recently had occasion to travel on horseback from Denver, Colorado, to Cheyenne, Wyoming, a distance of one hundred and ten miles, by the road which, for a considerable part of the way, coincided with the line of the telegraph. It was over rolling prairie, crossed by a few affluents of the South Platte, along the eastern base of the Rocky Mountains. The most abundant birds of this stretch of country, at the time (October), were horned larks (*Eremophila*), flocks of which were almost continually in sight; and the next most characteristic species was Maccown's bunting (*Plectrophanes Maccownii*). Almost immediately upon riding by the telegraph wire, I noticed a dead lark; and as I passed several more in quick succession, my attention was aroused. The position of the dead birds enabled me to trace cause and effect, before I actually witnessed a case of the killing. The bodies lay in every instance nearly or directly beneath the wire. A crippled bird was occasionally seen fluttering along the road. Becoming interested in the matter, I began to count, and desisted only after actually counting *a hundred* in the course of one hour's leisurely riding — representing perhaps a distance of three miles. Nor was it long before I saw birds strike the wire, and fall stunned to the ground; three such cases were witnessed during the hour. One bird had its wing broken; another was picked up dying in convulsions from the force of the blow. The eyeballs of several dead ones I examined were started from their sockets, and the feathers of the forehead were torn off, indicating a violent blow upon the head; but in most cases there was left no outward mark of the fatal internal injury. Along some particular stretches of wire where, for whatever reason, birds had congregated, the dead ones averaged at least one to every interval between the poles; sometimes two or three lay together, showing where a flock had passed by, and been decimated. The great majority of the birds destroyed consisted of larks; I noticed perhaps half a dozen buntings, one meadow starling (*Sturnella magna neglecta*), and one green-winged teal (*Querquedula Carolinensis*). The proportion of larks was probably due in the main simply to their greater abundance; but I presume that their singularly wayward, impulsive flight may have increased the risk of striking the wires. They were the only birds I saw knocked down; and I noticed, or fancied I noticed, some hesitation and confusion in their flight when the flocks crossed the line of wire.

From these facts, which I simply narrate, one may attempt to estimate, if he wishes, the extent of the destruction which, as I have already said, goes on incessantly. Given, one hundred dead birds to three miles of wire, all killed, perhaps, within a week; or, given three birds seen to strike and fall in an hour; how many are annually killed by the telegraph wires of the United States? I should be sorry to suppose, however, that the rate of destruction I witnessed is not at or near the maximum;

for I have seldom seen more birds to the acre than during the day to which I particularly refer, and never under circumstances more likely to result in the disaster of which I speak.

Usually, a remedy has been or may be provided for any unnecessary or undesirable destruction of birds; but there seems to be none in this instance. Since we cannot conveniently abolish the telegraph, we must be content with fewer birds. The only moral I can discern is that larks must not fly against telegraph wires.

RECENT LITERATURE.

Powell's Exploration of the Colorado River.[1] **Second Notice.** — Our notice of the second part of this admirable report has been long deferred, but the portion on the structural geology of the region possesses additional interest on account of the publication of Major Powell's report on the geology of the Uinta Mountains, among which one branch of the Colorado, the Green River, takes its rise. As a contribution to the theory of formation of mountains the report is one of special interest. The Rocky Mountains, our author shows, have been carved out by rains and running water from a great block of sedimentary rocks which suffered erosion from the time of its first appearance above the sea. The peculiar form of the mountains is due largely to the soft nature of the rocks and the dryness of the climate. "Though little rain falls, that which does is employed in erosion to an extent difficult to appreciate by one who has only studied the action of water in degrading the land in a region where grasses, shrubs, and trees bear the brunt of the storm. A little shower falls, and the water gathers rapidly into streams and plunges headlong down the steep slopes, bearing with it loads of sand, and for a few minutes, or a few hours, the district is traversed by brooks, and creeks, and rivers of mud. . . . . When a great fold emerges from the sea, or rises above its base level of erosion, the axis appears above the water (or base level) first, and is immediately attacked by the rains, and its sands are borne off to form new deposits." Thus the mountains have never perhaps been higher above the level of the sea than at present; for example, the "Uinta Mountains were not thrust up as peaks, but were carved from a vast, rounded block left by a retiring sea, or uplifted from the depths of the ocean, and their present forms are due to erosion!"

As to the drainage of this plateau Mr. Powell concludes "that the present drainage was established in rocks now carried away from the higher regions, but [with remnants] still seen to be turned up against the flanks of most of the ranges." Thus the present river valleys in some cases are of great geological antiquity. The relation of the present river valleys to folds and faults is discussed at length. The author finds that the relation of the direction of the streams to the dip of the rocks is very complex. He divides the valleys into two orders, transverse and longitudinal. Of the first order three varieties are noticed: *diaclinal* (Figure 64), those which pass through a fold; *cataclinal* (Figure 65),

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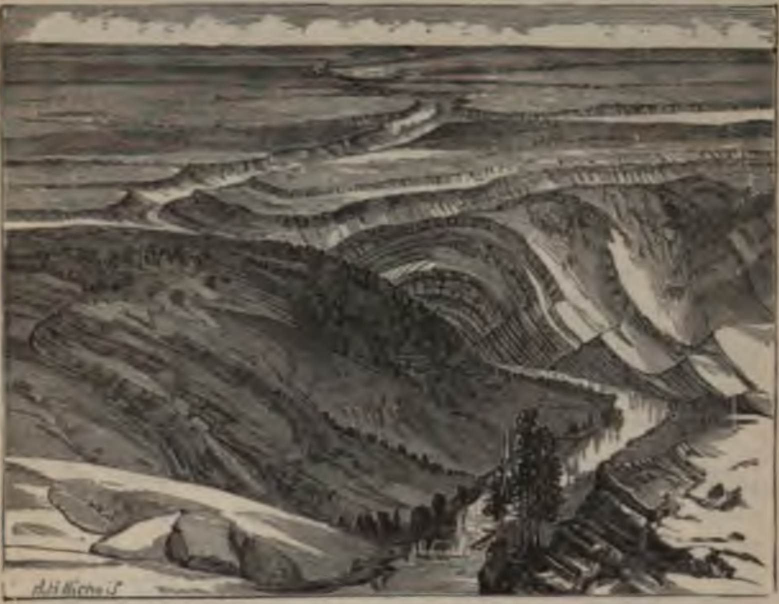
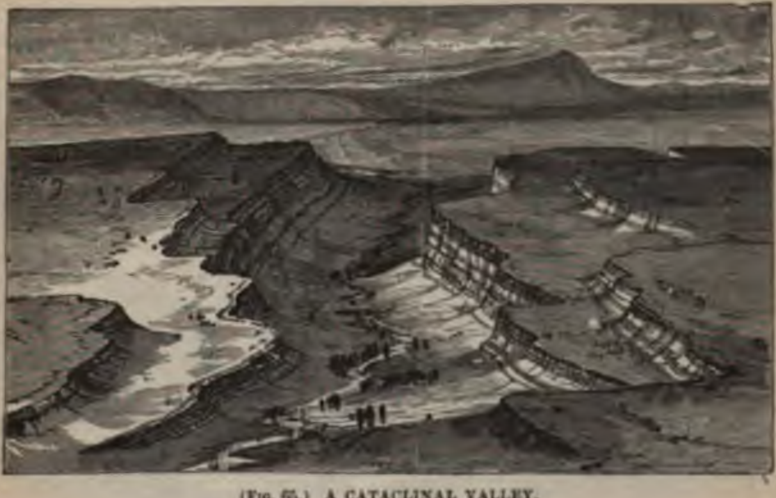
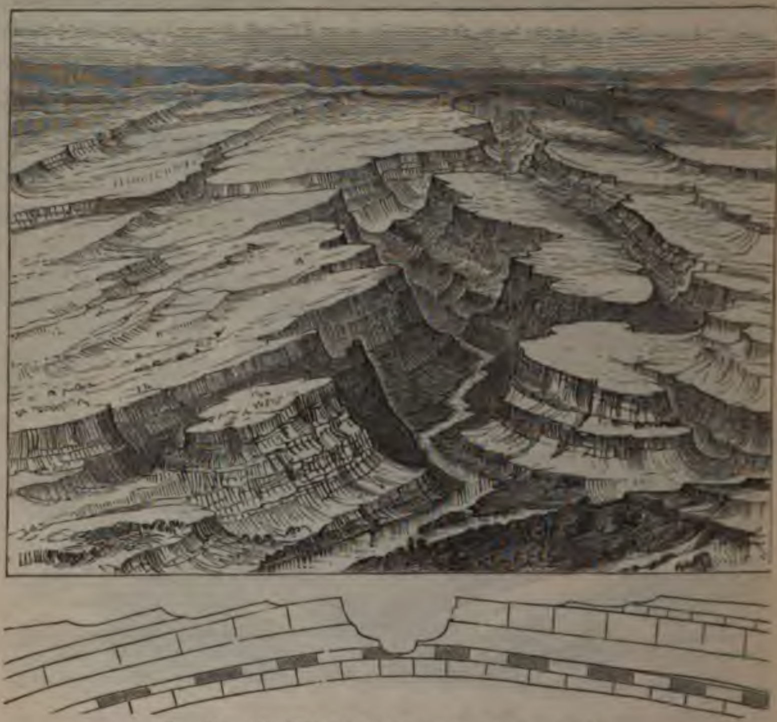
[1] *Exploration of the Colorado River of the West and its Tributaries.* Explored in 1869, 1870, 1871, and 1872, under the Direction of the Secretary of the Smithsonian Institution. Washington. 1875. 4to, pp. 291. With Map and Plates.


A.H.Nichols S.

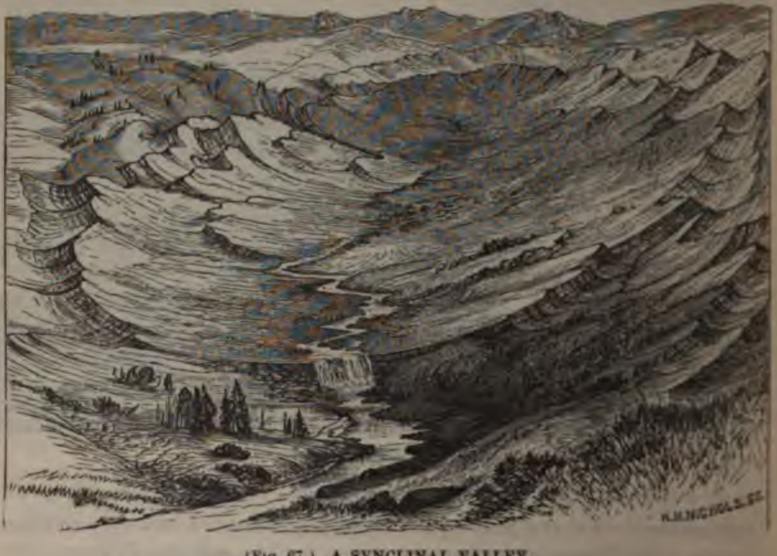
(FIG. 64.) A DIACLINAL VALLEY.



(FIG. 65.) A CATACLINAL VALLEY.



(Fig. 66.) AN ANTICLINAL VALLEY, WITH SECTION.


W.H.NICHOLS SC.

(Fig. 67.) A SYNCLINAL VALLEY.

valleys that run in the direction of the dip; *anaclinal*, valleys that run against the dip of the beds. Of the second order there are *anticlinal* valleys (Figure 66), which follow anticlinal axes; *synclinal* valleys (Figure 67), which follow synclinal axes; and *monoclinal* valleys, which run in the direction of the strike between the axes of the fold — one side of the valley formed of the summits of the beds, the other composed of the cut edges of the formation. This classification rests solely, the author adds, on typical examples, one form often running into another.

One who is quite ignorant of geology will find the report exceedingly interesting, while the professional geologist, in whose hands the volume has now been for over a year, has doubtless profited by its perusal.

DAVIES' PREPARATION AND MOUNTING OF MICROSCOPIC OBJECTS.[1] — As a brief and compact manual of the art of preparing and mounting microscopic objects we always supposed that the present one was probably the best. The second edition is a still more useful book, and has been specially adapted by the editor for the use of medical students and young practitioners. For general use, however, we can recommend it as a cheap and reliable book.

HUXLEY AND MARTIN'S BIOLOGY.[2] — A notice, by a most competent critic, of the first edition of this excellent manual appeared in the April number of the NATURALIST. This second edition is issued at a lower price, and contains a number of corrections and alterations, the pages having been entirely reset.

JORDAN'S MANUAL OF THE VERTEBRATES OF THE NORTHERN UNITED STATES.[3] — To those desirous of a cheap manual for the ready identification of our land and fresh-water vertebrates, we should unhesitatingly recommend this book as well compiled and convenient, while the price makes it generally accessible. The characters of the classes and orders are much abbreviated, and the generic characters are confined to a key, "while for specific characters, only such points have been generally retained as are distinctive as well as descriptive." The classification is based on that of recent authors, and no important innovations seem to have been suggested by the author.

In order to test the part related to reptiles and batrachians we have identified several species, before unknown to us, with ease and certainty. The objection to such books as this is that the brief and condensed descriptions are apt to be unsatisfactory in critical cases, but as the author distinctly states that the manual is designed for "collectors and students who are not specialists," we do not see but that the object has been gained, and the plan very well carried out.

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[1] *The Preparation and Mounting of Microscopic Objects.* By THOMAS DAVIES. Second Edition, greatly enlarged. Edited by J. MATHEWS, M. D. New York: G. P., Putnam's Sons. 1876. 12mo, pp. 214. $1.25.

[2] *A Course of Practical Instruction in Elementary Biology.* By T. H. HUXLEY, assisted by H. N. MARTIN. Second Edition, revised. London and New York: Macmillan & Co. 1876. $2.00.

[3] *Manual of the Vertebrates of the Northern United States.* Including the District east of the Mississippi River, and north of North Carolina and Tennessee, exclusive of Marine Species. By DAVID STARR JORDAN, M. S., M. D. Chicago: Jansen, McClurg, & Co. 1876. 12mo, pp. 342. $2.00.

RECENT BOOKS AND PAMPHLETS. — Manuscript Notes from my Journal; or, Illustrations of Insects, Native and Foreign. Order Hemiptera, Suborder Heteroptera, or Plant-Bugs. By Townsend Glover. Washington. 1876. 4to, 10 Plates, pp. 132.

Report of Explorations across the Great Basin of the Territory of Utah for a Direct Wagon-Route from Camp Floyd to Genoa, in Carson Valley, in 1859. By Capt. J. H. Simpson, Corps of Topographical Engineers, U. S. A. Washington. 1876. 4to, pp. 518. With Map and Plates.

Report of the Exploring Expedition from Santa Fé, New Mexico, to the Junction of the Grand and Green Rivers of the Great Colorado of the West, in 1859, under the Command of Capt. J. N. Macomb. With Geological Report, by Prof. J. S. Newberry. U. S. Engineer Department. Washington, D. C. 1876. 4to, pp. 148. With Maps and Plates.

Geological Survey of Michigan, Lower Peninsula. Palæontology. Fossil Corals. By Dr. C. Rominger, State Geologist. (Advance Copy, unrevised by the Author.) New York: Julius Bien. 1876. 4to, pp. 132. With 10 Plates.

Le Helicopsyche in Italia. Lettera agli Entomologi Italiani di Carlo de Siebold. 8vo, pp. 10.

Report on the Geological Map of Massachusetts, prepared by W. O. Crosby, Prof. Alpheus Hyatt in Charge. Under the Direction of the Massachusetts Commission to the Centennial Exposition. Boston. 1876. 8vo, pp. 52.

Insects Injurious to the Potato and Apple. By Prof. G. H. Perkins, Ph. D. (From Third Report of State Board of Agriculture.) Rutland, Vt. 1876. 8vo, pp. 46.

Concerning the Fishes of the Ichthyologia Ohiensis. By David S. Jordan, M. S., M. D. (From the Bulletin of the Buffalo Society of Natural Sciences.) Buffalo. 1876. 8vo, pp. 7.

Hydrographic Sketch of Lake Titicaca. By Alexander Agassiz. (Reprinted from the Proceedings of the American Academy of Arts and Sciences, xi. 1876.) 8vo, pp. 9.

Exploration of Lake Titicaca. By Alexander Agassiz and S. W. Garman. III. List of Mammals and Birds. By J. A. Allen, with Field Notes by Mr. Garman. IV. Crustacea. By Walter Faxon. (Bulletin of the Museum of Comparative Zoölogy, iii. nos. 15 and 16.) July, 1876. 8vo, pp. 26.

On the Development of the Crustacean Embryo, and the Variations of Form exhibited in the Larvæ of Thirty-Eight Genera of Podophthalmia. By C. Spence Bate, F. R. S. (From the Proceedings of the Royal Society of London.) 8vo, pp. 4.

Die Aussern Lebensverhaltnisse der Seethiere. Von Prof. Carl Moebius. 4to, pp. 4.

Check-List of Preparations and Objects in the Section of Human Anatomy of the United States Army Medical Museum. For use during the International Exhibition of 1876, in connection with the representation of the Medical Department United States Army. No. 8. By George A. Otis, M. D., U. S. A. Washington, D. C. 1876. 8vo, pp. 135.

Hat Man in den interglaciären Ablagerungen in der Schweiz wirkliche Spuren von Menschen gefunden oder nur Spuren von Bibern. Von J. Steenstrup. (From Archiv für Anthropologie.) 1876. 4to, pp. 4.

The Prehistoric Remains which were Found on the Site of the City of Cincinnati, Ohio, with a Vindication of the "Cincinnati Tablet." By Robert Clarke. Cincinnati. 1876. 8vo, pp. 34.

GENERAL NOTES.

BOTANY.[1]

Notes on Alpine and Subalpine Plants in Vermont. — Now that the frosts have seared vegetation here, and our mountains are white with snow, I can make a full report to you of my summer's work in botanizing. I have occupied myself chiefly with a careful examination of the higher mountains of Vermont, and find their plants much more Alpine in character than they have heretofore been credited with being, so that in the next edition of your manual you need not, in giving the distribution of several species at least, skip over the Green Mountains in passing from the White Mountains to the Adirondacks.

On the summit of Mount Mansfield I have found *Diapensia Lapponica*, *Vaccinium cæspitosum*, and *Asplenium viride*, and on the summits of both Mansfield and Camel's Hump, *Polygonum viviparum*, *Salix Cutleri*, *Nabalus Bootii*, and *Aspidium fragrans*.

But I must tell you in particular of a region lying under the eastern base of the north peak of Mansfield, which is vastly richer in Willoughby plants than Willoughby itself. It is a narrow and deep gorge separating the bases of Mansfield and Sterling mountains. Through this "pass" runs a trail from Stowe Valley on the south to Cambridge in the Lamoille Valley on the north. It has long borne the name of "Smuggler's Notch," and will be remembered as the place where Pursh first discovered *Aspidium aculeatum* var. *Braunii*. Several botanists, since Pursh's day, have visited the station of this fern, — Tuckerman and Macrae and Frost, certainly, — but like Pursh they seem not to have left the trail except to gather supplies of the fern, which grows all over the bottom of the valley. The floor of the defile is strewn with masses of sharply angled rock which have fallen from the cliffs five hundred to one thousand feet high on either side. But a few rods from the trail, either to the right or left, we come to the foot of steep declivities formed of the finer débris from the cliffs, and covered like the whole valley with moderately-sized specimens of *Betula lutea* and other northern trees. It is from an eighth to a fourth of a mile to the top of these declivities, whence rise the perpendicular cliffs. These precipices extend along the sides of the pass for half a mile or more, being somewhat higher and more extensive on the western or Mansfield side than on the other. They are not continuous, but wherever streams of water from the mountain-sides extending high above fall over them, at least during spring and fall, they are broken into by deep clefts and chutes receding far backward and upward beyond their summits. Between these clefts sheer precipices like rounded towers rise hundreds of feet, and their dry summits are capped with a stunted growth of *Abies alba*.

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[1] Conducted by Prof. G. L. Goodale.

So, what with these dry and exposed rocks, with recesses always moist and shaded, a great diversity of situation is offered to plants. In one or two places, where the shade is deepest and the supply of moisture most abundant and constant, grows *Aspidium fragrans.* (This I have several times met with this season, under two of the precipices of the summit of Mansfield, at the base of the cliff of Camel's Hump near *Woodsia glabella,* and about Indian Falls on the Winooski River, in a line between these two mountains.) *Asplenium viride,* scarce under the south cliff of the summit of Mansfield, grows abundantly in thick tufts and mats all along the shaded bases of both the eastern and western cliffs, and in the deeper woods near by, and follows far up the mountain a stream which comes down from the "Lake of the Clouds," just below the summit of the north peak of Mansfield. *Saxifraga Aizoon,* seen only at Willoughby in some score of specimens, in this region carpets the open slopes and shelves all over these cliffs, just as *Antennaria plantaginifolia* covers the soil of old sterile fields. *S. aizoides* clings to all the moist rocks wherever it can get a foothold, and *S. oppositifolia* is only a little less common.

Of *Woodsia glabella* there is ten times as much here as Mr. Croydon and I found at Willoughby the past season, upon a close examination of the mountains on both sides of the lake, and it has planted itself in so many places impossible of access except to the birds that there is no danger of its ever being exterminated here.

The following plants are scattered freely over the cliffs: *Conioselinum Canadense, Artemisia Canadensis, Aster graminifolius, Hedysarum boreale, Astragalus alpinus, Carex scirpoidea,* and *Calamagrostis stricta.*

These three Willoughby plants I did not observe: *Arabis petræa, Draba incana,* and *Primula Mistassinica,* though it is quite possible that a visit made earlier than August, when I first entered the valley, might be rewarded by the discovery of the latter. As an offset to these, however, in the comparison of this Mansfield region with the Willoughby region we have, besides the two or three ferns already mentioned, *Pinguicula vulgaris* almost as abundant as the Saxifrages.

When the fearful drought of the past summer was at its height I spent most pleasantly several days in this cool and fresh mountain valley. Though I climbed to nearly every accessible place among the cliffs, I do not suppose I found every good thing the region holds.

A *Woodsia* which I found on one of the cliffs of Mansfield, proves to be *W. hyperborea.*

I also inclose a panicle of a *Calamagrostis* from Smuggler's Notch, which, if it be not *Langsdorffii,* seems to me to be near that species. [It appears to be *C. Langsdorffii.* — A. G.]

The range of the following plants may be extended. I have picked up on the shore of Lake Champlain, *Hierochloa borealis;* on the shore of the lake in Shelburn, Vt., as well as about the Lake of the Clouds, on Mansfield, *Carex lenticularis*, and on the banks of the Winooski River, a few miles above the station of *Astragalus Robbinsii*, that rare grass, *Graphephorum melicoides*. Also, in this vicinity, *Vilfa vaginæflora*, and northward, on the sandy plains near the lake, *Eragrostis pertinacea:* also on the lake shore, *Physostegia Virginiana.* — *Communicated in a letter to Prof. A. Gray by* C. G. PRINGLE.

[Among Mr. Pringle's interesting discoveries should also be enumerated the rare *Habenaria rotundifolia*, found by him at Monkton, Vermont. A. G.]

THE TWO BITTER-SWEETS. — One of the greatest difficulties that persons ignorant of botany have to contend with is the confusion of English names. Two plants, say, of very remote relationship or none at all, have come by some accident to be spoken of by the same title. An emigrant from the old country, finding a plant in the new that reminds him of home, calls it by the suggested name. Possibly some one in the next county applies the same title to an entirely different thing. Even here, in the United States, one cannot depend upon local names, which differ according to the tastes and fancies of the giver. Recognizing this difficulty, science has established a fixed nomenclature understood by all civilized peoples. When a name is given in this technical language it is understood in Russia or Switzerland as well as in America.

Our attention is at present attracted to this subject by the question which is put to us, "What is the difference between the two plants called bitter-sweet?" The bitter-sweet (*Solanum dulcamara*) is a plant of the nightshade family, with clusters of lilac or purple-colored, potato-like blossoms opening all summer. Generally one will find on the same specimen both flowers and fruit, and the last in varying conditions of maturity. Green and bright translucent red berries are often borne on the same stem. Now, this climber or half shrub, which is found everywhere about dwellings or trailing over walls, although not absolutely known to be poisonous, is still of doubtful relationship. The berries should be kept out of the hands of children. The plant is adventive from Europe, but is well established.

The shrubby or climbing bitter-sweet or staff-tree is polygamo-diœcious, the small greenish flowers appearing in June. The plant is a regular twiner, and often grows to a great height in trees. It is found along streams and lakes, and we have generally seen it fruiting best near tidewater. It is the *Celastrus scandens* of botanists, and belongs to the order *Celastraceæ*. It sometimes has the local name of Roxbury waxwork. The charm of this plant is in its beautiful orange-colored pods, which in late autumn open and reveal the scarlet arils of the seeds. Clusters of these fruits are very beautiful in winter decorations displayed over pictures or mirrors. The well-known burning-bush (*Euonymus*) belongs to the same family. So far as we know, the *Celastrus* is innocent, but the *Euonymus* is reputed dangerous. Neither of the plants known as bitter sweet is poisonous to the touch. — W. W. BAILEY.

THE NUTRITION OF PLANTS. — Sig. Cugini l to the *Nuovo Giornale Botanico Italiano* a very alimentation of cellular plants. In his Text- arranges the elements which are necessary to th three series, in the order of their importance, thu

Carbon, Hydrogen, Oxygen, Nitroge
Potassium, Calcium, Magnesium, Iro
Phosphorus, Chlorine.

Cugini would arrange them thus, in five series

Carbon, Hydrogen, Oxygen, Ni
Sulphur.
Potassium, Phosphorus.
Iron, Magnesium,
Silicon.

The modes in which these elements are co serve for the nutrition of the plant are expresse of the proximate food-materials of plants, —

Necessary	Organic carbon-compounds,	
	Water,	
	An ammoniacal salt,	
	Sulphates of potassium and i	
	Phosphate of magnesium,	
	An alkaline silicate.	
Occasional	Chloride	of sodium or potas
	Iodide	
	Bromide	
	Phosphate, nitrate, or sulphat	
	Salts of zinc, manganese, and	

Potassium the author considers to have an a tion from that of any other element, and to b relationship to the carbohydrates to that which albuminoids. Calcium he does not regard as a Iron must be considered so from its peculiar rel matter of chlorophyll. He is unable to assign magnesium, although it appears to be essential.

THE RELATIVE FERTILITY OF CROSS-FER FERTILIZATION. — It is generally known that M a special work on this subject, to which he has tion. In the mean time the botanist who has p contributed most to our knowledge of the rel mode of fertilization in plants, Professor Del lished the results of his own observations. He lization in different plants into the following k pollinate and fecundate the stigma of the same *homoclinic homogamy.* (2.) The anthers polli stigma in another flower of the same infloresce are hermaphrodite, unisexual, or polygamous: (3.) The anthers of one flower pollinate and fe flower belonging to a different inflorescence c whether hermaphrodite, unisexual, or polygam *amy.* (4.) The anthers of a flower on any individual plant pollinate and fecundate only the flowers on a different individual, whether the flowers be hermaphrodite, polygamous, monœcious, or diœcious: *dichogamy.* A number of experiments on the artificial fecundation of plants in the four different modes indicated above point to the conclusion that their relative fertility is in the inverse order to that in which they have been mentioned. Professor Delpino promises an additional paper on cleistogamous or closed self-fertilized flowers. — A. W. BENNETT.

ALPINE PLANTS OF THE WHITE MOUNTAINS. — We are glad to call attention to the following announcement: —

Collections of the Alpine and sub-Alpine plants of the White Mountains, N. H., containing more than fifty species, have been made during the past season, by William F. Flint and J. H. Huntington.

The number of sets is limited to fifty. They have been carefully arranged and ticketed, and will be sent by mail upon the receipt of five dollars ($5.00). Address William F. Flint, Hanover, N. H. (Box 348.)

BOTANICAL PAPERS IN RECENT PERIODICALS. — *Comptes rendus,* No. 8. Saintpierre and Magnieu, Researches on the Gas contained in the Fruits of *Colutea arborescens.* No. 9. De Luca, On the Alcoholic and Acetic Fermentation in the Fruits, Flowers, and Leaves of certain Plants. L. Fautrat, On the Influence exerted by Pine Forests on the Amount of Rainfall. No. 10. Renault, On the Silicified Plants of Autun.

Flora, No. 26. Nylander, New Cuban Lichens (Species of Ramalina) from Mr. Charles Wright's Collections. De Krempelhuber, New Brazilian Lichens. No. 27. De Thümen, Fungi from South Africa.

Botanische Zeitung, No. 37. Philippi, Notes on *Fuchsia macrostemma* and its Near Relatives. Philippi, Note respecting the Production of Wood after Injury in *Acacia decipiens.* No. 38. Reports of Societies. Sorokin, On *Morchella bispora.* No. 39. Salomonsen, On the Isolation of Different Forms of Bacteria. No. 40. Schenk, On Fossil Equisetaceæ.

ZOÖLOGY.

NEW SHELLS FROM COLORADO. — Mrs. M. A. Maxwell, of Boulder, Colorado, exhibited at the Centennial Exhibition a large number of animals and birds which attracted a great deal of attention. She brought with her a box of miscellaneous land and fresh-water shells gathered in the immediate vicinity of her home at Boulder, which is a few miles northeast of Denver, at an elevation above the sea of about 5535 feet. These shells she kindly entrusted to me for examination, and they seem to me worthy of notice, as they add materially to the previously known molluscan fauna of the State. In my report upon the Mollusks of Colorado, published by Dr. F. V. Hayden in 1874,[1] I endeavored to give the entire list of mollusks then known to inhabit Colorado, and also all within the Great Plains on the east and the crests of the Sierra Nevada range on the west, these being the limits assigned by Mr. W. G. Binney to his "Central Province." "Tabulating the sum of the information open to me, and including my own summer's work, I found that one hundred and thirty-eight nominal species had been recorded as occurring in this inter-montanic region. Of these forty-nine were also Californian species; fifteen occurred also in the Eastern United States; eight hailed from the Colorado Desert; seven were found all over the continent, eight all over the world, and three belonged in the Eastern Province west of the Alleghanies only. This left forty-seven nominal species whose range, so far as yet known, is confined to the Central Province." To this list I am now able to add six new names, as follows: ? *Limnea lepida* Gld. ? *Physa inflata* Lea. *Planorbis bicarinatus* Say. *Goniobasis pulchella* Anth. *Goniobasis livescens* Menke. *Anodonta* —— ?

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[1] Annual Report of the United States Geological and Geographical Survey, 1874, pages 385–410. The Mollusks of the Rocky Mountains: Popular Science Monthly, vol. ix., May, 1876.

All of these are new not only to Colorado, but to the whole province, so far as I can ascertain, except *Planorbis bicarinatus*, which has been reported from the Yellowstone. It will be observed that all of these are Eastern forms, except the Anodon, which may turn out to be new, or related to Californian species. We very much need further collections from these mountainous territories, the least of which will cast some light upon the geographical distribution of our mollusks over the extensive and greatly diversified areas which they inhabit, the conditions which determine their being wide-spread or restricted in their range, and the variations which may manifest themselves in form or habit.

Following is given a list of Mrs. Maxwell's collection, with remarks:

Zonites arboreus Say. Many specimens. Common in the State.

Zonites fulvus Drap. Several specimens of this very common shell.

Patula Cooperi W. G. B. Said to be abundant about Boulder, which is the first mention of its occurrence on the eastern slope of the range. Among the large number of specimens several are marked very distinctly from all the rest with "broader longitudinal and spiral patches of reddish brown," or burnt umber, as is mentioned in Binney's original description. They are difficult to distinguish from *P. solitaria.* As usual nearly all of the shells were found dead. The species seems to be dying out.

Patula striatella Anth. Four specimens.

Helix pulchella Müll. Abundant.

Cionella subcylindrica L. A few.

An exceedingly minute *Vertigo* with toothed aperture is represented by three specimens, but I cannot yet determine it.

Succinea lineata W. G. B. Several specimens.

Succinea Nuttalliana Lea. Two examples of a variety differing from the type mainly in having a smoother external surface.

? *Limnea lepida* Gld. Some young specimens, probably referable to this species.

Limnophysa desidiosa Say. Several specimens; not uncommon in that region.

Limnophysa humilis Say. Some examples of this shell, which is probably numerous throughout the Territories.

? *Physa inflata* Lea. Dr. James Lewis, who examined the fluviatiles of this collection, queries this identification, but admits that the type extends from Virginia to Colorado. Mr. Binney regards it as a synonym of *P. heterostropha.* There seem to be two specimens, of different ages.

Physa heterostropha Say. Many specimens of various sizes, but as near New York shells as well can be. It is hard to draw the boundary of variation here. Some of the specimens are thickly coated with rust from the iron-waters in which they have lived, and others with a white deposition accumulated from the water. They occur in great abundance everywhere among the mountains.

There is a *Bulinus* which looks as if it might be a variety of *B. hypnorum*, but is scarcely identifiable with that species.

Planorbis (*Helisoma*) *plexata* Ing. Three examples of this species, first described from my specimens, are among this lot, the largest and oldest one showing the twisted appearance very plainly.

Planorbis bicarinatus Say. This well-known shell is now first reported from Colorado, but has been found on the Yellowstone. These examples are of average size. The common *P. trivolvis* is not included in this collection.

Gyraulus parvus Say. Quantities of this shell, very common in Colorado.

Two imperfect specimens represent a diminutive *Ancylus* which it is difficult to name, but which somewhat resembles *A. diaphana.*

Goniobasis pulchella Anth. Several characteristic examples.

Goniobasis livescens Menke. A number of specimens.

Anodonta ——? There is a single well-preserved example of an Anodon to which Dr. Lewis says he knows no reference, but has seen similar ones (not named) from California. It is about two inches long, brown and smooth without, somewhat decorticated over a large area, at the beaks, and lustrous blue within, changing to bronze under the hinges. Several much smaller ones of similar shape, but lighter-colored and thinner, may be the young of the former. If, as Dr. Lewis suggests, this should prove to be an undescribed species, it ought certainly to be dedicated to the energetic naturalist to whose intelligence and care we are indebted for this interesting collection of Colorado mollusks.

Sphærium striatinum Lam. Two specimens in fine condition, of medium size, but varying somewhat from the type toward *S. sulcatum.*

Pisidium abditum Hald. A large quantity of these shells which are vastly abundant in places all through the West. — Ernest Ingersoll.

ANTHROPOLOGY.

ANTHROPOLOGICAL NEWS. — The Academy of Natural Sciences of Davenport, Iowa, has issued its first volume of proceedings, covering the time from 1867 to 1876. The volume is well illustrated by plates, chiefly archæological, and is certainly a praiseworthy effort by an infant society. There are a large number of archæological papers reported, relating principally to mound explorations in the State and in Whiteside County, Illinois. The papers by Dr. Farquharson are of extraordinary merit, especially in those portions which relate to the copper axes and to the cloth wrappings found on many of them.

The third number of the *Revue d'Anthropologie* has appeared, rich in original matter and in reviews of progress. The first article is by M. Tissot, upon the megalithic monuments and the blonde populations of Morocco. The monuments are precisely similar in nature to those found in Western Europe and in Algiers, consisting of dolmens, tumuli, menhirs, and cromlechs. The inhabitants of Morocco consist of: (1) two races of European physiognomy, the one blonde, the other brown, corresponding to the two races, blonde and brown, found in France (Libyans par excellence); (2) a brown race with southern characteristics, but still European (Getules ?); (3) a brown race of Oriental origin (Numidians ?); (4) a brown race, probably Berber, but crossed with the black race (Melano-Getules).

M. Broca, the editor, follows up the paper of M. Tissot with a learned discussion of the relation of these megalithic remains to those of Algiers, particularly as settling the mooted question of a migration into Africa through Sicily and Sardinia rather than across the Straits of Gibraltar. M. Broca in referring to the blonde Berbers combats the theory of Shaw that they are the descendants of the Vandals of Genseric. From allusions in classic authors we are led to infer the presence of this blonde element for at least fifteen centuries B. C. The works of M. de Löher are referred to, and an address of congratulation to him quoted as an example of the slight evidence which will suffice a philologist when his national preferences overrule his judgment.

The second article is an account of an elaborate study upon Netherland crania, by Dr. Sasse. The next article is by Mme. Clemence Royer, a very diligent student but not always a safe guide, upon the origin of funeral rites and their manifestations in prehistoric times. It is an attempt to apply the evolution hypothesis to the subject of sepulture. The instinctive veneration for the dead is traced primarily to the natural abhorrence of dead bodies inspired in most animals by their poison, their infection, and the abundance of stinging flies, etc., which gather around them. This has led some apes to cover their dead with boughs and sticks. From these the modes of burial naturally follow. The first great class is where the corpse is not touched, including absolute abandonment, slight coverings, heaps of stones, tumuli, cave and hut abandonment, etc. The first occurrence of touching the corpse was where the instinct of preservation, induced by crowding, overcame the fear of the dead, and thus by the transporting of the dead of one cave to the side of a dead relative in another, an act of devotion saves the cave dwelling to the occupants and originates the whole series of interments in which the corpse is moved. The most ingenious application is made of these theories to inhumation, abandonment to beasts and birds, throwing into rivers and into the sea, desiccation and embalming, exposure on scaffolds, incineration, etc. An attempt is made in the last chapters to trace out ethnic affinities by these modes of burial.

Dr. A. Morice contributes an article upon acclimation in Cochin China. The reviews upon anthropological publications and researches are exceedingly fine, especially that of Dr. Collineau upon the craniological and craniometric instructions of the Anthropological Society of Paris, occupying nearly thirty pages of finely printed matter and illustrated with ten wood-cuts. The bibliographical references alone render this periodical absolutely indispensable to the anthropological student.

The eighth number of *Matériaux* contains a review of Count J. Gozzadini's charming monograph upon some bronze horse-trappings from Italy and the bronze sword of Ronzano. The original is fully illustrated with plates. James C. Southal's Recent Origin of Man is reviewed by M. L. Reoult de Neuville. The remainder of the number is taken up with matters purely French.

The Rede Lecture for 1876, The Monumental History of Egypt, was delivered May 26th by Samuel Birch. It is published in pamphlet form by Samuel Bagster.

The third session of the International Congress of Orientalists was opened at St. Petersburg, Friday, September 1st, with M. Gregorrew as president. Nine sections were formed and a chairman elected for each. The subjects to which the sections were devoted were as follows: (1.) East and West Siberia. (2.) Middle Asia within Russian boundaries, as well as the independent principalities of Western Turkestan. (3.) Caucasia, as well as the Crimea and other parts of European Russia inhabited by Asiatic peoples. (4.) Transcaucasus, including ancient Georgia and Armenia. (5.) Eastern Turkestan, Thibet, Mongolia, with Mantchooria and the Corea, China, and Japan. (6.) India, Afghanistan, Persia, and the Indo-Chinese Archipelago. (7.) Turkey, including Arabia and Egypt. (8.) Archæology and Numismatics. (9.) The Religious and Philosophical Systems of the East.

M. Leon de Rosny, the president of Section 5, called the attention of the congress to the question of the discovery of America by the Chinese before the time of Columbus.

The meeting of the British Association for the Advancement of Science commenced September 6th. The president of the biological section also opened the subsection of anthropology. In his address, after giving a brief and general sketch of the modern doctrine of the antiquity and origin of man, Mr. Alfred R. Wallace devoted the remainder of his remarks to the far more momentous and exciting problem of the development of man from some lower animal form. He observed that in the last sixteen years scientific men have passed from one extreme of belief to the other, — from a profession of total ignorance as to the mode of origin of all living beings to a claim of almost complete knowledge of the whole progress of the universe from the first speck of protoplasm up to the highest development of the human intellect. Mr. Wallace, believing that the facts which oppose this theory receive hardly their due attention, that opposition is the best incentive to progress, and that it is not well even for the best theories to have it all their own way, directed the attention of his hearers to some of the facts, and to the conclusions fairly deducible from them.

Papers were read by Lieutenant Cameron, Mr. Pengelly, M. Tiddemann, and Professor Barrett.

The French Association for the Advancement of Science met August 16th at Clermont. M. Gabriel de Mortillet was chosen president of the Section of Anthropology. The subject of his opening address was the Origin of Superstitions. Papers were read by MM. Broca, Tubino, Ollier de Marchand, Vacher, Roujon, and Hovelacque.

The American Archæological Convention met in Philadelphia, in the Centennial Judges' Hall, on the 6th of September. A permanent organization was formed, called the American Anthropological Association, with Dr. C. C. Jones as president and Rev. H. D. Peet as secretary. — O. T. Mason.

GEOLOGY AND PALÆONTOLOGY.

Cretaceous Vertebrates of the Upper Missouri. — Professor Cope has recently returned from an exploration of the Fort Union beds of the Upper Missouri, especially those discovered by Dr. Hayden in 1855 at the mouth of the Judith River. Attention was given to the relation of this formation to the underlying marine cretaceous beds, and to the respective faunæ of the two as compared with that of the early eocene period. The fauna was found to be terrestrial and lacustrine, including great numbers of *Unionidæ*, *Lepidosteus*, *Ceratodus*, and a form probably of rays; of crocodiles, fresh-water turtles, Sauropterygian and Dinosaurian reptiles. The *Dinosauria* constitute the most abundant and characteristic form of life, eighteen species having been found, of which eight were of the carnivorous (*Goniopodous*) and ten of the herbivorous (Orthopodous) type. The predominant genus of the former is *Lælaps*, of the latter, *Dysganus*, of both of which several species were found.

The facies of this fauna is thus plainly mesozoic and cretaceous, adding weight to the arguments already adduced to this effect. But the change from the fauna of the underlying cretaceous numbers four and five is very striking, the genera and often higher groups being quite different. The types of the marine beds were found to be *Pythonomorpha*, *Elasmosaurus*, *Plesiosaurus*, *Enchodus*, chimærids and sharks, with marine *Cephalopoda*, etc. Nevertheless the physical transition between the marine and lacustrine formations appears to be complete, as indicated by Professor Hayden.

POWELL'S GEOLOGY OF THE UINTA MOUNTAINS.[1] The field work reported on by this important volume was done between the years 1868 and 1875, among the Uinta Mountains and adjacent regions, covering portions of Wyoming south of the Pacific Railroad and of Utah. This region is of great general geological interest, and its geology has been discussed by Major Powell in an able and original way. Particular attention has been paid to facts relating to mountain-building, the amount of denudation and displacement of strata in these mountains being fully discussed and graphically represented. The Bird's-Eye View of a Part of the Uinta Uplift, in the atlas, well illustrates the author's manner of representing the orography of an extensive plateau area. The formations described have an aggregate thickness of fifty thousand feet, and embrace groups of palæozoic, mesozoic, and cenozoic age. The palæontology has been elaborated by Dr. C. A. White. The geological maps and sections are of a high degree of interest and of much practical importance.

GEOGRAPHY AND EXPLORATION.

RETURN OF THE BRITISH ARCTIC EXPEDITION.—The following note is condensed from the newspaper reports. The British Arctic Expedition under Captain Nares returned to England, October 27th. The Alert and Discovery left Fort Foulke on July 29, 1875, and entered the ice off Cape Sable. After a severe and continuous struggle they reached the north side of Lady Franklin Bay, where the Discovery was left in winter quarters. The Alert pushed on and reached the limit of navigation on the shore of the Polar Sea. The ice varied in thickness, being in some places one hundred and fifty feet thick. President Land does not exist.

The Alert wintered in latitude 82° 27′. At this point the sun was invisible one hundred and forty-two days, and a temperature the lowest ever recorded was experienced, being fifty-nine degrees below zero for a fortnight, and falling once to one hundred and four degrees below the freezing point. A detachment with sledges was dispatched northward. It was absent seventy days, and reached latitude 83° 20′. Another party rounded Cape Columbia, the northwest point of America, and traced two hundred and twenty miles westward from Greenland, and also explored far to the eastward.

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[1] Report on the Geology of the Eastern Portion of the Uinta Mountains and a Region of Country adjacent thereto. With Atlas. By J. W. Powell. Washington. 1876. 4to, pp. 218.

During the sledge journeys the ice was so ragged that it was only possible to advance a mile a day.

During the winter rich collections in natural history were made and many valuable scientific observations were taken. Excellent coal was found near the place where the Discovery wintered.

A member of the expedition telegraphs to the *Daily News* that the northernmost land reached was in latitude 83° 07′. After that there was ice. The point farthest west reached was in longitude 85°. Lady Franklin's Straits are really a bay. Petermann Fiord was closed by a glacier. The northernmost point of Greenland seen was in latitude 82° 57′.

THE NEW ROUTE TO CHINA. — The following details are given in the daily papers of the remarkable discovery of Professor Nordenskiold, the Swedish explorer, already reported by telegraph: —

"He reports having encountered no obstacles, and considers the way now quite open from Europe to China *via* the northern passage and the valley of the Yenisei River, by which steam communication is obtained across Siberia and almost to the frontiers of China. An immense unmeasured area of extremely fertile and valuable soil was found in this region, all of which is accessible for immediate cultivation.

"The commercial value and the important results to flow from this demonstration of the feasibility of a northeastern passage to Siberia and China can hardly be foreseen or overestimated. Nordenskiold, whose letter is unfortunately brief, writes that he has also obtained results of great interest to science. Dredging and scientific observations were constantly carried on during the entire voyage. Large accessions have been made to the previously obtained collections from this heretofore unknown region. One of the unexpectedly favorable phenomena of the passage, the professor reports, was that the water was uniformly found to be surprisingly warm."

MICROSCOPY.[1]

VAN DER WEYDE'S OBLIQUE ILLUMINATOR. — At the Indianapolis meeting of the American Association for the Advancement of Science, in August, 1871, P. H. Van der Weyde, of New York, described a contrivance, believed to be new, for oblique illumination of transparent objects. It was designed chiefly to facilitate the resolution of lined or dotted objects, and consisted of a plane mirror lying beneath the object-slide and parallel to it, from which mirror light, condensed upon it from above by means of a bull's-eye condenser would be reflected back at the same angle through the object and into the objective. These illuminators were shown in successful operation at the meeting, working best with moderately high powers, and were freely distributed among the members present. They were briefly described in the NATURALIST for

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[1] Conducted by DR. R. H. WARD, Troy, N. Y.

September, 1871, being there estimated as "a little expedient of great practical convenience." Ever since that time the present writer, among others, has used them habitually, shown them freely, and not unfrequently given them away. The mirror may be either of silvered glass or of polished metal. In some cases the object-slide may lie directly upon it while it rests upon the stage; but frequently the object-slide is best elevated slightly above it. The mirror is most conveniently made of the size of a slide (3x1) and furnished with glass strips at the ends to support the slide at any required height; but it may be made smaller, say one inch square or round, and sunken in a brass or wooden stage-plate, or for stands having a sub-stage of any kind it may be made of suitable size and supported from the sub-stage and adjusted for height in the same manner as the achromatic condenser. It has the advantage of great ease of manipulation and applicability to any stand, and the drawback of being liable to be interfered with by the presence on the slide of such obstructions as paper covers or opaque cells or rings of varnish. Within a few months past it has been brought forward by Rev. John Bramhall, of Lynn, England; its previous use and publication having either escaped the notice or slipped from the memory of himself as well as of the distinguished microscopist who has indorsed it and proposed to name it after him.

THE RICHMOND FOSSIL EARTH. — The recent excavation of a tunnel by the Chesapeake and Ohio Railroad Company, through that part of the city of Richmond, Va., known as Church Hill, has intersected this famous deposit for a distance of three fourths of a mile, and afforded rare facilities for study and the collection of material. C. L. Peticolas of Richmond, who has given great attention to the work of obtaining this interesting material and preparing it for use, describes the stratum as from forty to sixty feet thick, and situated, nearly level, about fifteen to twenty-five feet below the level of the city and one hundred feet above tide water. Before exposure to the air it is tough and hard, having the color and solidity of bituminous coal and requiring to be removed from the tunnel by means of blasting; but after exposure for some time it crumbles to a fine powder of almost snowy whiteness, consisting in general of about one half fine pure clay, one fourth fine white sand, and one fourth fossil diatoms interspersed with many sponge spicules and a few Polycystina. The abundance and variety of the fossil forms vary greatly in different parts of the stratum, the lower levels being the richer.

MICRO-PHOTOGRAPHS IN HISTOLOGY. — The monthly series of illustrations of normal and pathological histology, by Dr. Carl Seiler in connection with Drs. J. G. Hunt and J. G. Richardson, has advanced sufficiently far to indicate its character but not its scope. The numbers contain four plates each, representing microscopical views of tissues, mostly human, printed by a photo-mechanical process that gives the

appearances under the lens with the rigid cand
Of the selection of objects it is impossible to
The text is a slightly amplified description
will be a luxury to those who are not practic
scope, and a convenience, as an excellent n
are.

Volatilized Gold. — Mr. John Hewst
Cal., has prepared beautiful mounts of gold c
ing chambers connected with the smelting fur
state of brilliant globules of pure metal, and
be continually taking place during the smeltin

Diatoms as Fertilizers. — The miserab
presence of diatoms in the tissues of plants a
portance to the plants as food, which inadve
American Journal of Science and Arts for Ju
been intended as a hoax, after all. It look
lesque upon the follies of scientific puffing of
was almost impossible to consider it as inten
has been exposed sufficiently long, however,
Journal of Microscopy, to give ample time f
out, and in absence of proof to the contrary i
of the most preposterous advertising tricks o
its absurdities it is hardly worth while serious
ful value of infusorial earths as fertilizers,
effects upon some kinds of soil.

Exchanges. — Julien Deby, C. E., of
studying the fossil diatoms of Belgium, and
Belgian material of this class for specimen
Also, correspondence desired in regard to exch
imens and publications. Mr. Deby may be a
of this department, 53 Fourth Street, Troy, N

Slides of gold-bearing quartz from Califo
jects; polarizing preferred. S. R. Hatch, Mi

SCIENTIFIC NEW

— So alarming and wide-spread have been t
the trans-Mississippi States and Territories,
that there is a general demand by the peopl
tional action in investigating the habits and
the ravages of the migratory locust of the
accordance with a call issued a few weeks ago
Minnesota, a meeting of the governors of the
tories took place in Omaha, Nebraska, Octob
rid the country of the grasshopper pests. T

as follows: Nebraska, Governor Silas Garber, ex-Governor Furnas, Professor Wilbur, and Prof. A. D. Williams; Dakota, Governor John L. Pennington; Minnesota, Governor Pillsbury, Professor Whitman, and Mr. Pennock Pusey; Iowa, Governor Kirkwood; Illinois, Prof. C. W. Thomas of Carbondale, Governor Beveridge being ill; Missouri, Governor Hardin and Prof. C. V. Riley.

The meeting was organized by the election of Governor Pillsbury as chairman, and Professor Riley and Mr. Pusey as secretaries.

The Governor of Minnesota made a brief address on the objects of the meeting, and suggested that steps be taken to memorialize Congress to appoint a commission of scientific men to visit the districts suffering from the grasshopper pest, and investigate the subject.

This brought out a discussion which was participated in by nearly all the gentlemen present, the most important speeches being made by Governor Pennington of Dakota, Professor Riley of Missouri, Governor Kirkwood of Iowa, Professor Thomas of Illinois, and ex-Governor Furnas of Nebraska.

Prof. C. V. Riley briefly narrated the habits and history of the pest, and gave sound practical advice. He considered that there were two main questions before the conference: first, the consideration of how best to deal with the young insects that threaten to hatch out over a vast extent of the country next spring, and second, the investigation of the insect in its native home, with a view of preventing its migrations into the country to the southeast. For the first, he advised some well-digested plan of action that would give confidence to the people and insure concert of action; mentioning, among other things, the offering of rewards by the several States and counties for the eggs and newly hatched hoppers, as recommended in his last report, and systematic burning and ditching. For the second, he urged an appeal to Congress to add a special appropriation to the sundry civil service bill, to defray the expenses of a commission of three experts, to be appointed by and to work under Prof. F. V. Hayden, in charge of the United States Geological Survey of the Territories, who, with his experience and skill in organization, could materially assist such a commission. In the evening the conference met again and, after deliberating, appointed a committee of six, composed of the chairman, Messrs. Riley, Osborn, Wilbur, Thomas, and Williams, to present a series of resolutions and suggestions for the farmers of the country, and a memorial to Congress for discussion and adoption.

— Count Gaston de Saporta, the distinguished French botanical palæontologist, has recently been appointed to a professorship in the Jardin des Plantes in Brongniart's place.

— Mr. S. E. Cassino, Naturalists' Agency, Salem, Mass., announces the publication in December of The Land-Birds and Game-Birds of New England, by H. D. Minot, 8vo, 400 pages; and in January of a Naturalist Directory, which we are sure will prove very serviceable and timely.

— Under date of September 29th, Prof. O. A. Derby, of the Brazilian

Geological Commission under Prof. Ch. Fre
(Derby), H. H. Smith, and Senhor Freitas h
sand feet of Devonian beds below the Ereré b
Smith and himself. Of this, several hundred fe
rich in fossils of Devonian aspect, including N
istic species. Carboniferous beds occur in the
have a complete section from the base of the I
tions, in the lower Amazonian valley.

— At the meeting of the National Academy
adelphia, October 17–19, 1876, the following
members: G. F. Barker, J. A. Allen, W. M.
John Newton. The following papers on na
The Results of an Investigation upon the Tra
multiformis, by Alpheus Hyatt; On the Geolo
graphical Aspects of the Catskill Mountains,
Physical Structure and Altitudes of the Soutl
kill Mountains, by Arnold Guyot.

— The forty-sixth annual session of the B
Advancement of Science was opened Septembe
address of the president, Professor Andrews.
the opening address before the geological se
that in the section of biology, Prof. Alfred Ne
ment of zoölogy and botany of the section of
Evans that in the section of geography. Sect
physical science, was presided over by Sir
made some flattering allusions to the present
physical science.

— The French Association for the Advanc
meeting in August, under the presidency of M.

— On September 12th the geographical c
King of Belgium met at Brussels, under the pr

— As regards *Bathybius*, which is now agai
however in clerical than in scientific circles, i
Professors Wyville Thompson and Huxley hav
whether this is an organism, Dr. Bessels, of th
covered in Smith's Sound a form almost exactl
however, he judged to be still simpler than *B*
named *Protobathybius*. A description and a fi
drawings and notes furnished by the author in
of Animals. Even if *Bathybius* should prove
Protobathybius Robesonii left, and several allie
such as *Protamœba protogenes*, and others, wl
masses of protoplasm, even without a nucleus
plants, it matters not which, but most probably
Haeckel in his *Monera*, a division of organism
recent paper.

PROCEEDINGS OF SOCIETIES.

Academy of Natural Sciences, Philadelphia. — July 25th. Dr. Allen called attention to a photograph of a Brahmin bull, exhibiting the growth from the back of the animal of a supernumerary anterior extremity. The peculiarities of the limb were described, and its importance from an embryological point of view was alluded to. Mr. Martindale stated that the bull spoken of by Dr. Allen had been removed to Newark, but that there was still on exhibition a heifer having two anterior limbs growing from the shoulders.

Mr. Meehan called attention to a peculiar diurnal motion he had observed in *Liatris pycnostachya* when throwing up its flower stems: the top was always curved over towards the east in early morning, nearly erect at midday, and towards the west at sundown. For commercial purposes he had thousands of plants growing, and the habit was uniform in all. The motion was evidently vertical and not in a horizontal direction, and this still left it open to ascertain how the point turned towards the east for its early morning start. As soon as the flower spike approached its full growth the motion ceased.

Professor Cope spoke of the development of the upper incisors in a species of fossil camel. The species had been called *Procamelus heterodontus*, but it had recently been found that the true *Procamelus* does not present a complete series of upper incisors. The stages of growth of the teeth of *Procamelus* were described, and the genus having the perfect series of incisors was named *Protolabis*. The name *Protolabis heterodontus* was proposed for the type. A new species of *Procamelus* was indicated under the name *fissidens*.

A letter from Joseph Menges, of Frankfort-on-the-Main, applying for assistance to enable him to explore the region of the Red Sea, was, on motion, referred to the council.

Professor Kerr called attention to a peculiar feature of surface geology of North Carolina. No well-characterized evidence of the glacial age had been found as far south as South Carolina, but in the foot-hills east of the Blue Ridge occurred peculiar superficial deposits, the nature of which had been for some time uncertain. The gold of North Carolina occurs in gravel beds as in California, at the upper surface of the rock upon which such sandy deposits lie. The beds alluded to were evidently not moved by water, and the material of which they are composed shows a peculiar succession of forms of deposits, proving them to be not moraines or the result of glacial action. Angular pebbles exhibiting no evidence of attrition are found some distance below the surface, towards the upper part of the hills. Lower down these pebbles are more rounded and are nearer the underlying rock. It was believed that the earth of the deposits had been frozen and had moved as if it were a glacier. The same characteristic deposit had been observed in the neighborhood of West Market Street, exhibiting features tending to strengthen the theory ad-

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